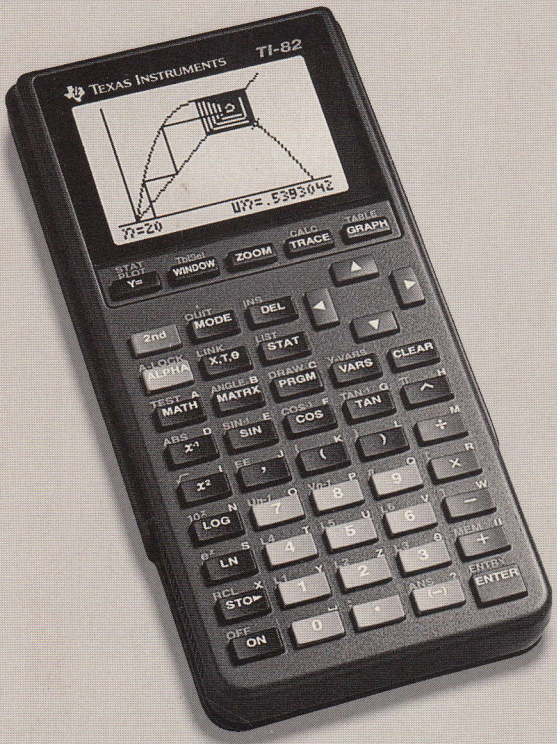
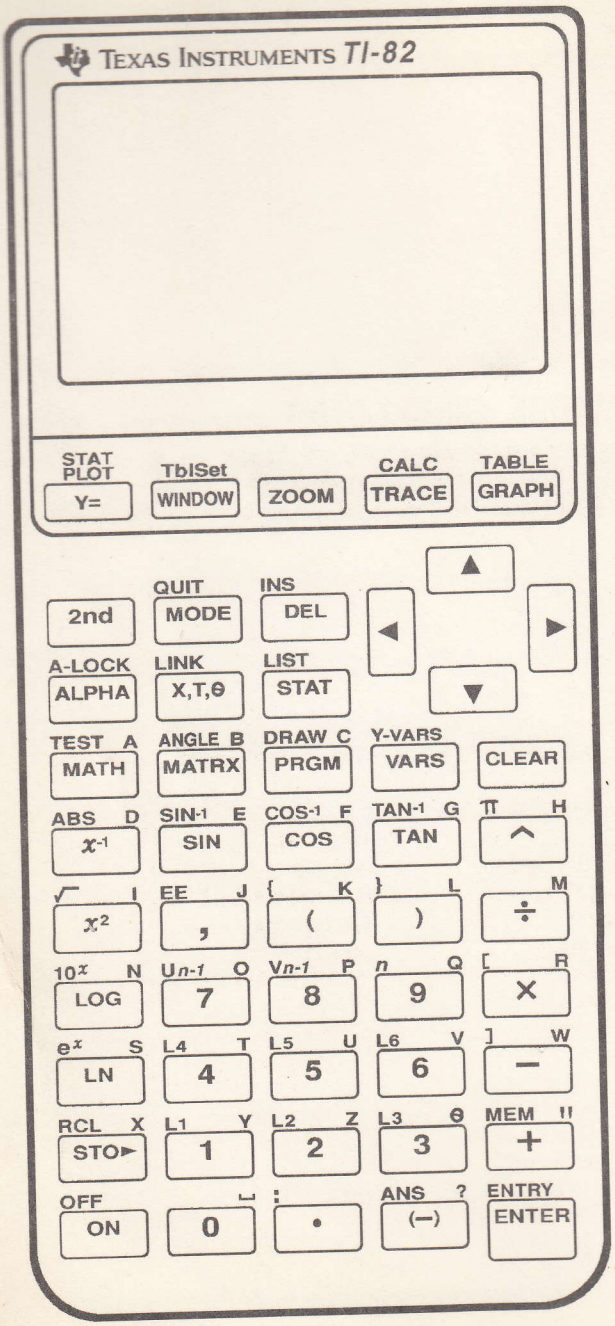
TEXAS INSTRUMENTS



TI-82

GRAPHICS CALCULATOR

GUIDEBOOK



TEXAS INSTRUMENTS

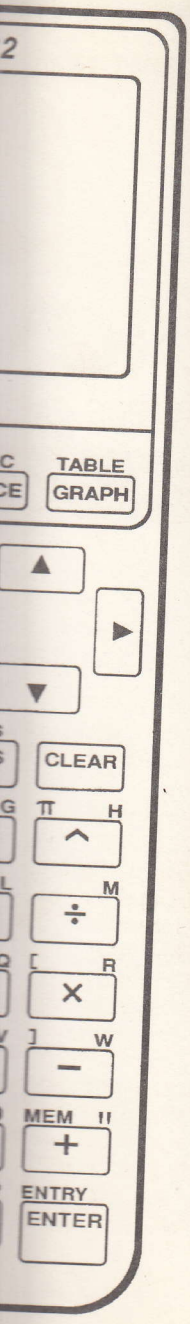
TI-82
GRAPHICS CALCULATOR
GUIDEBOOK

Guidebook developed by:
Texas Instruments Instructional Communi

With contributions by:
Richard G. Brown
Franklin Demana
Doug Feltz
Linda Ferrio
Greg Foley
Pat Hatcher
Michael Keyton
Pat Milheron
Jerry Murdock
Ann Phipps
Dave Santucci
John Stutzman
J. T. Sutcliffe
Chuck Vonder Embse
Bert K. Waits
C. B. Wilson
Lee E. Yunker
Richard G. Brown
Precalculus class
Phillips Exeter A
Chris Alexan
Juhi Asad
Angelique Co
Keith Getche
Elizabeth Gr
Suwha Hong
Toby Kiers
Emily B. La
April Leight
Kathryn Ma
Heather Me
Jason Paret
Mahalakshi
Enrique Sa

Copyright © 1993 by Texas Instruments Incorpo

IBM is a registered trademark of International Business Machine
Macintosh is a registered trademark of Apple Computer, Inc.



TEXAS INSTRUMENTS

TI-82
GRAPHICS CALCULATOR
GUIDEBOOK

Guidebook developed by:
Texas Instruments Instructional Communications

With contributions by:
Richard G. Brown
Franklin Demana
Doug Feltz
Linda Ferrio
Greg Foley
Pat Hatcher
Michael Keyton
Pat Milheron
Jerry Murdock
Ann Phipps
Dave Santucci
John Stutzman
J. T. Sutcliffe
Chuck Vonder Embse
Bert K. Waits
C. B. Wilson
Lee E. Yunker

Richard G. Brown's
Precalculus class at
Phillips Exeter Academy:
Chris Alexander
Juhi Asad
Angelique Cooper
Keith Getchell
Elizabeth Gray
Suwha Hong
Toby Kiers
Emily B. Law
April Leightty
Kathryn Mak
Heather Melanson
Jason Pareti
Mahalakshimi Sarju
Enrique Smith

Copyright © 1993 by Texas Instruments Incorporated.

IBM is a registered trademark of International Business Machines Corporation
Macintosh is a registered trademark of Apple Computer, Inc.

Important

Texas Instruments makes no warranty, either expressed or implied, including but not limited to any implied warranties of merchantability and fitness for a particular purpose, regarding any programs or book materials and makes such materials available solely on an "as-is" basis.

In no event shall Texas Instruments be liable to anyone for special, collateral, incidental, or consequential damages in connection with or arising out of the purchase or use of these materials, and the sole and exclusive liability of Texas Instruments, regardless of the form of action, shall not exceed the purchase price of this equipment. Moreover, Texas Instruments shall not be liable for any claim of any kind whatsoever against the use of these materials by any other party.

FCC Information Concerning Radio Frequency Interference

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference with radio communications. However, there is no guarantee that interference will not occur in a particular installation.

If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, you can try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/television technician for help.

Caution: Any changes or modifications to this equipment not expressly approved by Texas Instruments may void your authority to operate the equipment.

This digital apparatus does not exceed the Class B limits for radio noise emissions from digital apparatus set out in the Radio Interference Regulations of the Canadian Department of Communications.

Table of Contents

**This manual desc
Calculator. Gettin
features. The first
operating the TI-8
interactive feature
how to use these**

Using this Guideb
Glossary . . . . . .

Getting Started: Do This First!

TI-82 Menus . . .
First Steps . . . .
Entering a Calcula
Defining a Functio
Defining a Table o
Zooming In on the
Changing the View
Displaying and Tra
Zooming In on the
Finding the Calcul
Other Features .

Chapter 1: Operating the TI-82

Turning the TI-82
Setting the Displa
The Display . . . .
Entering Expressi
TI-82 Edit Keys .
Setting Modes . .
TI-82 Modes . . .
Variable Names .
Storing and Recal
Last Entry . . . . .
Last Answer . . . .
TI-82 Menus . . .
VARS and Y-VARS
EOS (Equation Op
Error Conditions

ity, either expressed or
any implied warranties of
rticular purpose, regarding any
kes such materials available

be liable to anyone for special,
al damages in connection with
of these materials, and the
Instruments, regardless of the
purchase price of this
ents shall not be liable for any
t the use of these materials by

found to comply with the
rsuant to Part 15 of the FCC
ovide reasonable protection
dential installation. This
adiate radio frequency energy
dance with the instructions,
radio communications.
nterference will not occur in

interference to radio or
termined by turning the
correct the interference by
s:

g antenna.
the equipment and receiver.
utlet on a circuit different
s connected.
nced radio/television

s to this equipment not
ents may void your authority

the Class B limits for radio
set out in the Radio
an Department of

Table of Contents

This manual describes how to use the TI-82 Graphics Calculator. Getting Started gives a quick overview of its features. The first chapter gives general instructions on operating the TI-82. Other chapters describe its interactive features. The applications in Chapter 14 show how to use these features together.

Using this Guidebook Effectively xiii
Glossary x

Getting Started: Do This First!

TI-82 Menus 2
First Steps 3
Entering a Calculation: Compound Interest 4
Defining a Function: Box with Lid 6
Defining a Table of Values 7
Zooming In on the Table 8
Changing the Viewing WINDOW 10
Displaying and Tracing the Graph 11
Zooming In on the Graph 12
Finding the Calculated Maximum 13
Other Features 14

Chapter 1: Operating the TI-82

Turning the TI-82 On and Off 1-2
Setting the Display Contrast 1-3
The Display 1-4
Entering Expressions and Instructions 1-6
TI-82 Edit Keys 1-8
Setting Modes 1-9
TI-82 Modes 1-10
Variable Names 1-12
Storing and Recalling Variable Values 1-13
Last Entry 1-14
Last Answer 1-16
TI-82 Menus 1-17
VARS and Y-VARS Menus 1-19
EOS (Equation Operating System) 1-20
Error Conditions 1-22

Chapter 2: Math, Angle, and Test Operations

Getting Started: Lottery Chances 2-2
Keyboard Math Operations 2-3
MATH MATH Operations 2-5
MATH NUM (Number) Operations 2-9
MATH HYP (Hyperbolic) Operations 2-11
MATH PRB (Probability) Operations 2-12
ANGLE Operations 2-13
TEST TEST (Relational) Operations 2-15
TEST LOGIC (Boolean) Operations 2-16

Chapter 3: Function Graphing

Getting Started: Graphing a Circle 3-2
Defining a Graph 3-3
Setting Graph Modes 3-4
Defining Functions in the Y= List 3-5
Selecting Functions 3-7
Defining the Viewing WINDOW 3-8
Setting WINDOW FORMAT 3-10
Displaying a Graph 3-11
Exploring a Graph with the Free-Moving Cursor . . . 3-13
Exploring a Graph with TRACE 3-14
Exploring a Graph with ZOOM 3-16
Using ZOOM MEMORY 3-19
Setting ZOOM FACTORS 3-21
Using CALC (Calculate) Operations 3-22

Chapter 4: Parametric Graphing

Getting Started: Path of a Ball 4-2
Defining and Displaying a Parametric Graph 4-3
Exploring a Parametric Graph 4-6

Chapter 5: Polar Graphing

Getting Started: Polar Rose 5-2
Defining and Displaying a Polar Graph 5-3
Exploring a Polar Graph 5-6

hances 2-2
s 2-3
..... 2-5
erations 2-9
Operations 2-11
Operations 2-12
..... 2-13
perations 2-15
erations 2-16

a Circle 3-2
..... 3-3
..... 3-4
Y= List 3-5
..... 3-7
OW 3-8
..... 3-10
..... 3-11
Free-Moving Cursor ... 3-13
ACE 3-14
OM 3-16
..... 3-19
..... 3-21
erations 3-22

all 4-2
Parametric Graph 4-3
ph 4-6

..... 5-2
olar Graph 5-3
..... 5-6

Chapter 6: Sequence Graphing

Getting Started: Forest and Trees 6-2
Defining and Displaying a Sequence Graph 6-3
Exploring a Sequence Graph 6-6

Chapter 7: Tables

Getting Started: Roots of a Function 7-2
Defining the Independent Variable 7-3
Defining the Dependent Variable 7-4
Displaying the Table 7-5

Chapter 8: DRAW Operations

Getting Started: Shading a Graph 8-2
DRAW DRAW Menu 8-3
Drawing Lines 8-4
Drawing Horizontal and Vertical Lines 8-5
Drawing Tangent Lines 8-6
Drawing Functions and Inverses 8-7
Shading Areas on a Graph 8-8
Drawing Circles 8-9
Placing Text on a Graph 8-10
Using Pen to Draw on a Graph 8-11
Drawing Points 8-12
Drawing Pixels 8-13
Storing and Recalling Graph Pictures 8-14
Storing and Recalling Graph Databases 8-15
Clearing a Drawing 8-16

Chapter 9: Split Screen

Getting Started: Polynomial Coefficients 9-2
Using Split Screen 9-3

Chapter 10: Matrices

Getting Started: Systems of Linear Equations 10-2
Defining a Matrix 10-4
Viewing Matrix Elements 10-5
Editing Matrix Elements 10-6
About Matrices 10-8
Matrix Math Functions 10-10
MATRIX MATH Operations 10-12

Chapter 11: Lists

Getting Started: Generating Sequences 11-2
About Lists 11-3
LIST OPS Operations 11-6
LIST MATH Operations 11-9

Chapter 12: Statistics

Getting Started: Building Height and City Size 12-2
Setting Up a Statistical Analysis 12-9
Viewing List Elements 12-10
Editing List Elements 12-11
STAT EDIT Menu 12-12
Statistical Analysis 12-13
Statistical Variables 12-14
Types of Statistical Analysis 12-15
Statistical Analysis in a Program 12-17
Statistical Plotting 12-18
Statistical Plotting in a Program 12-22

Chapter 13: Programming

Getting Started: Family of Curves 13-2
About Programs 13-4
Creating and Executing Programs 13-5
Editing Programs 13-6
PRGM CTL (Control) Instructions 13-7
PRGM I/O (Input/Output) Instructions 13-15
Calling Other Programs 13-18

Equations 10-2
..... 10-4
..... 10-5
..... 10-6
..... 10-8
..... 10-10
..... 10-12

ces 11-2
..... 11-3
..... 11-6
..... 11-9

l City Size 12-2
..... 12-9
..... 12-10
..... 12-11
..... 12-12
..... 12-13
..... 12-14
..... 12-15
..... 12-17
..... 12-18
..... 12-22

..... 13-2
..... 13-4
..... 13-5
..... 13-6
..... 13-7
s 13-15
..... 13-18

Chapter 14: Applications
Left-Brain, Right-Brain Test Results 14-2
Speeding Tickets 14-4
Buying a Car, Now or Later? 14-5
Graphing Inequalities 14-6
Solving a System of Nonlinear Equations 14-7
Program: Sierpinski Triangle 14-8
Cobweb Attractors 14-9
Program: Guess the Coefficients 14-10
The Unit Circle and Trigonometric Curves 14-11
Ferris Wheel Problem 14-12
Reservoir Problem 14-14
Predator-Prey Model 14-16
Fundamental Theorem of Calculus 14-18
Finding the Area between Curves 14-20

Chapter 15: Memory Management
Checking Available Memory 15-2
Deleting Items from Memory 15-3
Resetting the TI-82 15-4

Chapter 16: Communication Link
Getting Started: Sending Variables 16-2
TI-82 LINK 16-3
Selecting Items to Send 16-4
Transmitting Items 16-6
Receiving Items 16-7
Backing Up Memory 16-8

Appendix A: Tables
Tables of Functions and Instructions A-2
Menu Map A-22
Table of System Variables A-28

Appendix B: Reference Information
Battery Information B-2
In Case of Difficulty B-3
Accuracy Information B-4
Error Conditions B-6
Service Information B-10
One-Year Limited Warranty B-12

Index

Using this Guidebook Effectively

The structure of the TI-82 guidebook and the design of its pages can help you find the information you need quickly. Consistent presentation techniques are used throughout to make the guidebook easy to use.

Structure of the Guidebook

The guidebook contains sections that teach you how to use the calculator.

- Getting Started is a fast-paced keystroke-by-keystroke introduction.
- Chapter 1 describes general operation and lays the foundation for Chapters 2 through 13, which describe specific functional areas of the TI-82. Each begins with a brief Getting Started introduction.
- Chapter 14 contains application examples that incorporate features from different functional areas of the calculator. These examples can help you see how different functional areas work together to accomplish meaningful tasks.
- Chapter 15 describes memory management and Chapter 16 describes the communications link.

Page-Design Conventions

When possible, units of information are presented on a single page or on two facing pages. Several page-design elements help you find information quickly.

- **Page headings**—The descriptive heading at the top of the page or two-page unit identifies the subject of the unit.
- **General text**—Just below the page heading, a short section of bold text provides general information about the subject covered in the unit.
- **Left-column subheadings**—Each subheading identifies a specific topic or task related to the page or unit subject.
- **Specific text**—The text to the right of a subheading presents detailed information about that specific topic or task. The information may be presented as paragraphs, numbered procedures, bulleted lists, or illustrations.
- **Page "footers"**—The bottom of each page shows the chapter name, chapter number, and page number.

book and the design of information you need techniques are used ok easy to use.

that teach you how to use

keystroke-by-keystroke

peration and lays the ugh 13, which describe TI-82. Each begins with ction.

n examples that erent functional areas of s can help you see how k together to accomplish

management and nunications link.

on are presented on a s. Several page-design n quickly.

ive heading at the top of tifies the subject of the

page heading, a short eneral information about

Each subheading sk related to the page or

right of a subheading about that specific topic e presented as ures, bulleted lists, or

of each page shows the , and page number.

Information-Mapping Conventions

Several conventions are used to present information concisely and in an easily referenced format.

- **Numbered procedures**—A procedure is a sequence of steps that performs a task. In this guidebook, each step is numbered in the order in which it is performed. No other text in the guidebook is numbered; therefore, when you see numbered text, you know you must perform the steps sequentially.
- **"Bulleted" lists**—If several items have equal importance, or if you may choose one of several alternative actions, this guidebook precedes each item with a "bullet" (•) to highlight it—like this list.
- **Tables and charts**—Sets of related information are presented in tables or charts for quick reference.
- **Keystroke Examples**—The Getting Started examples provide keystroke-by-keystroke instructions, as do examples identified with a .

Reference Aids

Several techniques have been used to help you look up specific information when you need it. These include:

- A chapter table of contents on the first page of each chapter, as well as the full table of contents at the front of the guidebook.
- A glossary at the end of this section, defining important terms used throughout the guidebook.
- An alphabetical table of functions and instructions in Appendix A, showing their correct formats, how to access them, and page references for more information.
- Information about system variables in Appendix A.
- A table of error messages in Appendix B, showing the messages and their meanings, with problem-handling information.
- An alphabetical index at the back of the guidebook, listing tasks and topics you may need to look up.

Glossary

This glossary provides definitions for important terms that are used throughout this guidebook.

Expression An expression is a complete sequence of numbers, variables, functions, and their arguments that can be evaluated to a single answer.

Function A function, which may have arguments, returns a value and can be used in an expression.

A function is also the expression entered in the Y= editor used in graphing and TABLE.

Graph Database A graph database is composed of the elements that define a graph: functions in the Y= list, MODE settings, and WINDOW settings. They may be saved as a unit in a graph database to recreate the graph later.

Graph Picture A picture is a saved image of a graph display, excluding cursor coordinates, axis labels, tick marks, and prompts. It may be superimposed on another graph.

Home Screen The Home Screen is the primary screen of the TI-82, where expressions can be entered and evaluated and instructions can be entered and executed.

Instruction An instruction, which may have arguments, initiates an action. Instructions are not valid in expressions.

List A list is a set of values that the TI-82 can use for activities such as graphing a family of curves, evaluating a function at multiple values, and entering statistical data.

Matrix A matrix is a two-dimensional array on which the TI-82 can perform operations.

Menu Items Menu items are shown on full-screen menus.

Pixel A pixel (picture element) is a square dot on the TI-82 display. The TI-82 display is 96 pixels wide and 64 pixels high.

Variable A variable is the name given to a location in memory in which a value, an expression, a list, a matrix, or another named item is stored.

Getting Started: Do This First!

Getting Started contains two keystroke-by-keystroke examples, an interest rate problem and a volume problem, that introduce you to some principal operating and graphing features of the TI-82. You will learn to use the TI-82 much more quickly by completing both of these examples first.

Contents

TI-82 Menus 2
First Steps 3
Entering a Calculation: Compound Interest 4
Defining a Function: Box with Lid 6
Defining a Table of Values 7
Zooming In on the Table 8
Changing the Viewing WINDOW 10
Displaying and Tracing the Graph 11
Zooming In on the Graph 12
Finding the Calculated Maximum 13
Other Features 14

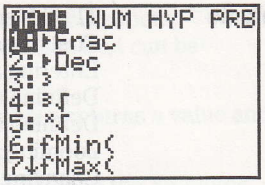
TI-82 Menus

To leave the keyboard uncluttered, the TI-82 uses full-screen menus to access many additional operations. The use of specific menus is described in the appropriate chapters.

Displaying a Menu

When you press a key that accesses a menu, such as [MATH], that menu screen temporarily replaces the screen where you are working.

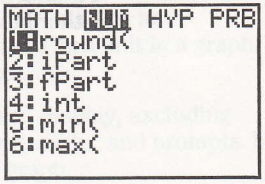
After you make a selection from a menu, you usually are returned to the screen where you were.



Moving from One Menu to Another

A menu key may access more than one menu. The names of the menus appear on the top line. The current menu is highlighted and the items in that menu are displayed.

Use [▶] or [◀] to display a different menu.

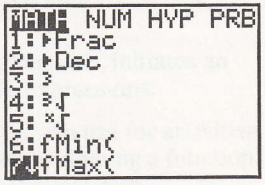


Selecting an Item from a Menu

The number of the current item is highlighted. If there are more than seven items on the menu, a ↓ appears on the last line in place of the : (colon).

To select from a menu:

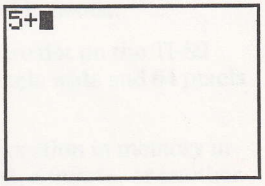
- Use [▼] and [▲] to move the cursor to the item and then press [ENTER].
- Press the number of the item.



Leaving without Making a Selection

To leave a menu without making a selection:

- Press [2nd] [QUIT] to return to the Home screen.
- Press [CLEAR] to return to the screen where you were.
- Select another screen or menu.



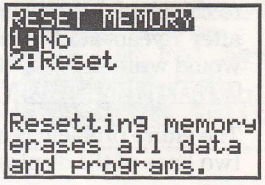
Before beginning these sample problems, follow the steps on this page to reset the TI-82 its factory settings. (Resetting the TI-82 erases all previously entered data.) This ensures that following the keystrokes in this section produces the same actions.

1. Press [ON] to turn the calculator on.
2. Press and release [2nd] and then press [+]. (Pressing [2nd] accesses the operation printed in blue to the left above the next key that you press. MEM is the 2nd operation of [+].)

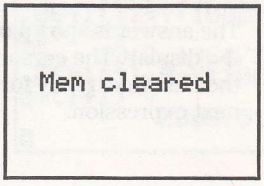
   The MEMORY menu is displayed.

3. Press **3** to select **Reset...**.

   The RESET MEMORY menu is displayed.



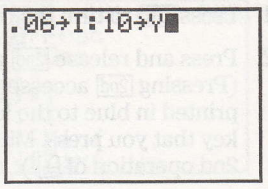
4. Press **2** to select **Reset**. The calculator is reset.
5. After a reset, the display contrast is also reset. If the screen is very dark or blank, you need to adjust the display contrast. Press [2nd] and then press and hold [▼] (to make the display lighter) or [▲] (to make the display darker). You can press [CLEAR] to clear the display.



Entering a Calculation: Compound Interest

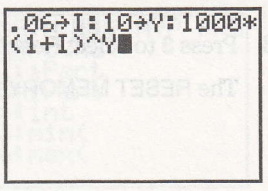
Using trial and error, determine when $1000 invested at 6% annual compounded interest will double in value. The TI-82 displays up to 8 lines of 16 characters so you see an expression and its solution at the same time. You also can store values to variables, enter multiple instructions on one line, and recall previous entries.

1. Press **.06** STO▸ ALPHA I (annual interest rate) to store the interest rate.
2. Press 2nd [:] to enter more than one instruction on a line.
3. For the first guess, compute the amount available at the end of 10 years. Enter **10** STO▸ ALPHA **Y** (years).



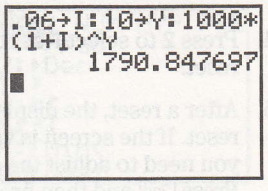
4. Press 2nd [:], then enter the expression to calculate the total amount available after **Y** years at I interest just as you would write it. Press **1000** × (**1** + ALPHA I) ^ ALPHA **Y**.

   The entire problem is shown in the first two lines of the display.



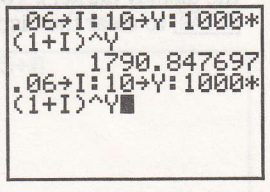
5. Press ENTER to evaluate the expression.

   The answer is shown on the right side of the display. The cursor is positioned on the next line, ready for you to enter the next expression.

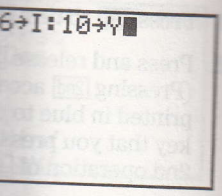


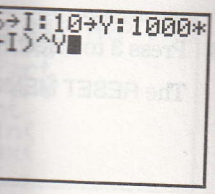
6. To save keystrokes, you can use Last Entry to recall the last expression entered and then edit it for a new calculation. Press 2nd, followed by [ENTRY] (above ENTER).

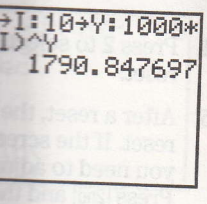
   The last calculated expression is shown on the next line of the display.

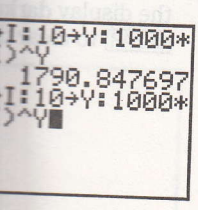


ested at 6% annual
TI-82 displays up to
on and its solution at
iables, enter multiple
tries.

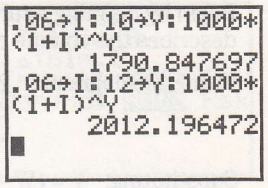






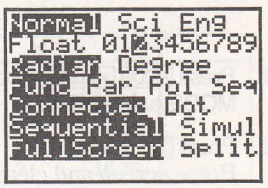


7. The next guess should be greater than 10 years. Make the next guess 12 years. Press ◄ to move the cursor over the **0**, and then type **2** to change **10** to **12**. Press [ENTER] to evaluate the expression.

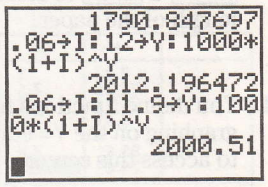


8. To display answers in a format more appropriate for calculations involving money, press [MODE] to display the MODE screen.

9. Press ▼ ► ► ► to position the cursor over the 2 and then press [ENTER]. This changes the display format to two fixed decimal places.

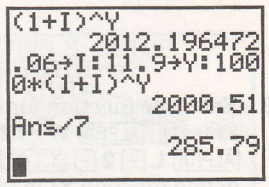


10. Press [2nd] [QUIT] (above [MODE]) to return to the Home screen. The next guess should be less than, but close to, 12 years. Press [2nd] [ENTRY] ▲ **1** [2nd] [INS] (above [DEL]) **.9** to change 12 to 11.9. Press [ENTER] to evaluate the expression.



11. If the amount above is to be divided among seven people, how much will each person get? To divide the last calculated amount by seven, press ÷ **7**, followed by [ENTER].

    As soon as you press ÷, **Ans/** is displayed at the beginning of the new expression. **Ans** is a variable that contains the last calculated answer.



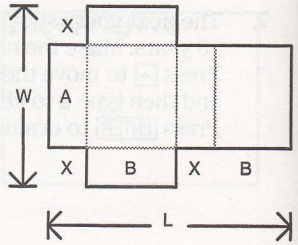
Defining a Function: Box with Lid

Take an 8½"×11" sheet of paper and cut X by X squares from two corners and X by 5½" rectangles from the other two corners. Now fold the paper into a box with lid. What X would give the maximum volume V of a box made in this way? Use tables and graphs to determine the solution.

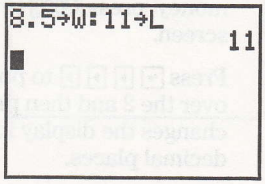
Begin by defining a function that describes the volume of the box.

From the diagram: $2X + A = W$
$2X + 2B = L$
$V = A\,B\,X$

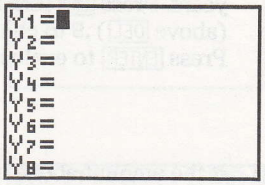
Substituting: $V = (W - 2X)\,(L/2 - X)\,X$



1. Press MODE ▼ ENTER to change the MODE back to **Float**.
2. Press 2nd [Quit] CLEAR to return to the Home screen and clear it.
3. Press **8.5** STO▸ ALPHA **W** 2nd [:] **11** STO▸ ALPHA **L** ENTER to store the width and length of the paper.

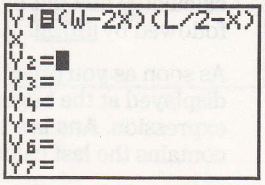


4. You define functions for tables and graphing on the Y= edit screen. Press Y= to access this screen.

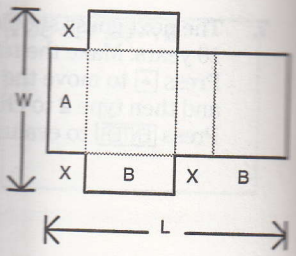


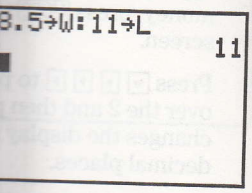
5. Enter the function for volume as **Y1**. Press (ALPHA **W** − **2** X,T,Θ) (ALPHA **L** ÷ **2** − X,T,Θ) X,T,Θ ENTER to define function **Y1** in terms of **X**. (X,T,Θ lets you enter **X** quickly, without pressing ALPHA.)

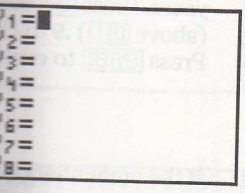
   The = sign is highlighted to show that **Y1** is selected.

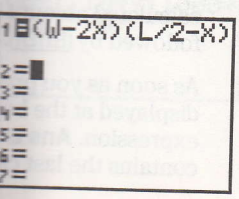


X squares from two
er two corners. Now fold
ve the maximum volume V
aphs to determine the





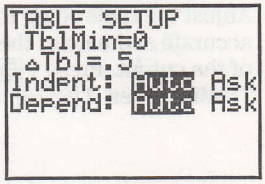




Defining a Table of Values

The table feature of the TI-82 provides numeric information about a function. Use a table of values from the previously defined function to estimate an answer to the problem.

1. Press [2nd] [TblSet] (above [WINDOW]) to display the TABLE SETUP menu.

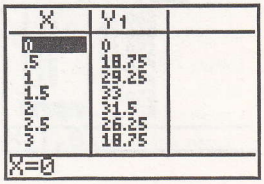


2. Press [ENTER] to accept **TblMin=0**.

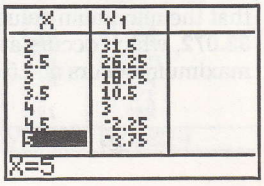
3. Press .5 [ENTER] to define the table increment **△Tbl=.5**. Leave **Indpnt: Auto** and **Depend: Auto** so the table will be generated automatically.

4. Press [2nd] [TABLE] (above [GRAPH]) to display the table.

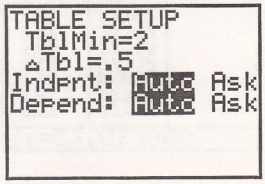
   Note that the maximum value is around **1.5**, between **1** and **2**.



5. Press and hold ▼ to scroll the table until the sign change appears. Note that the maximum length of **X** for this problem occurs where the sign of **Y1** (volume) becomes negative.



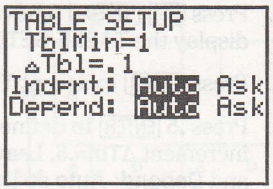
6. Press [2nd] [TblSet]. Note that **TblMin** has changed to reflect the first line of the table you last displayed.



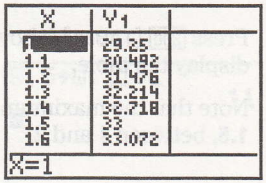
Zooming In on the Table

You can adjust the way a table is displayed to get more detailed information about any defined function. By varying the value of ΔTbl, you can "zoom in" on the table.

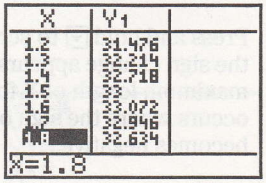
1. Adjust the table setup to get a more accurate estimate of the maximum size of the cutout. Press **1** [ENTER] to set **TblMin**. Press **.1** [ENTER] to set **ΔTbl**.



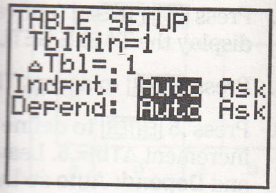
2. Press [2nd] [Table].

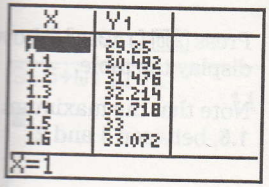


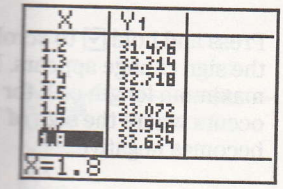
3. Use [▼] and [▲] to scroll the table. Note that the maximum value displayed is **33.072**, which occurs at **X**=1.6. The maximum occurs at 1.5<**X**<1.7.



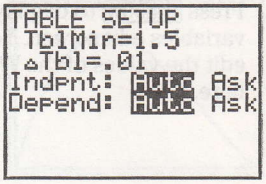
d to get more detailed
y varying the value of ΔTbl,



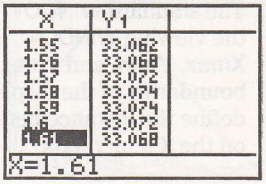




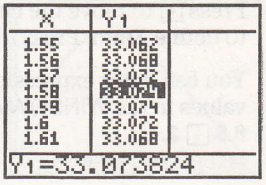
4. Press [2nd] [TblSet]. Press **1.5** [ENTER] to set **TblMin**. Press **.01** [ENTER] to set **ΔTbl**.



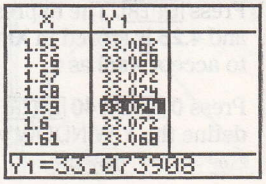
5. Press [2nd] [Table] and use ▼ and ▲ to scroll the table. Two "equal" maximum values are shown, **33.074** at **X=1.58** and **X=1.59**.



6. Press ▼ and ▲ to move the cursor to **1.58**. Press ▶ to move the cursor into the **Y1** column. The bottom line of the display shows the value of **Y1** at **1.58** in full precision, **33.073824**.



7. Press ▼ to display the "other" maximum. The value of **Y1** at **1.59** in full precision, **33.073908**. This would be the maximum volume of the box if you could cut your piece of paper at .01 inch increments.

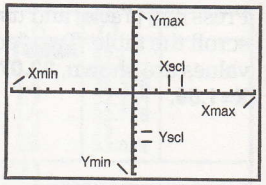


Changing the Viewing WINDOW

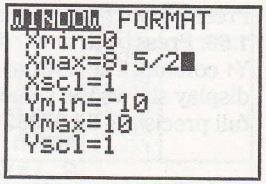
The viewing WINDOW defines the portion of the coordinate plane that appears in the display. The values of the WINDOW variables determine the size of the viewing WINDOW. You can view and change these values.

1. Press [WINDOW] to display the WINDOW variables edit screen. You can view and edit the values of the WINDOW variables here.

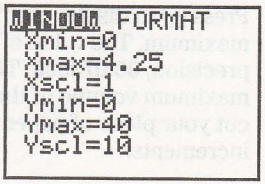
The standard WINDOW variables define the viewing WINDOW as shown. **Xmin**, **Xmax**, **Ymin**, and **Ymax** define the boundaries of the display. **Xscl** and **Yscl** define the distance between tick marks on the **X** and **Y** axis.



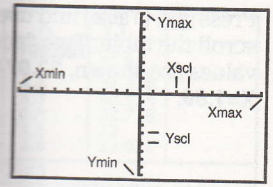
2. Press [▼] to move the cursor onto the line to define **Xmin**. Press **0** [ENTER].
3. You can enter expressions to define values in the WINDOW editor. Press **8.5** [÷] **2**.

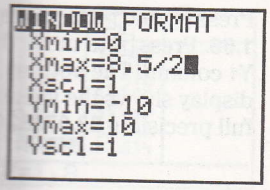


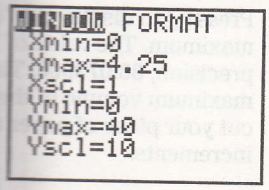
4. Press [ENTER]. The expression is evaluated and **4.25** is stored in **Xmax**. Press [ENTER] to accept **Xscl** as **1**.
5. Press **0** [ENTER] **40** [ENTER] **10** [ENTER] to define the **Y** WINDOW variables.



f the coordinate plane that
INDOW variables determine
iew and change these values.





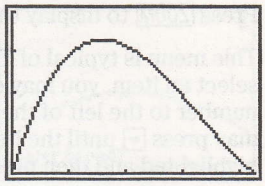


Displaying and Tracing the Graph

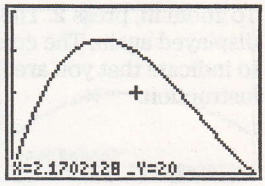
Now that you have defined the function to be graphed and the WINDOW in which to graph it, you can display and explore the graph. You can trace along a function with TRACE.

1. Press [GRAPH] to graph the selected function in the viewing WINDOW.

   The graph of **Y1=(W–2X)(L/2–X)X** is shown in the display.

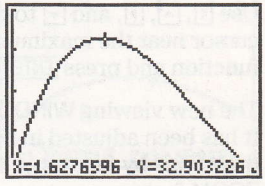


2. Press [▶] once to display the free-moving graph cursor just to the right of the center of the screen. The bottom line of the display shows the **X** and **Y** coordinate values for the position of the graph cursor.



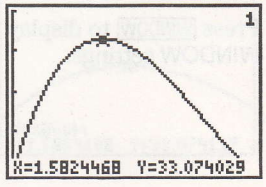
3. Use the cursor-keys ([◀], [▶], [▲], and [▼]) to position the free-moving cursor at the apparent maximum of the function.

   As you move the cursor, **X** and **Y** coordinate values are updated continually with the cursor position.



4. Press [TRACE]. The TRACE cursor appears on the **Y1** function near the middle of the screen. **1** in the upper right corner of the display shows that the cursor is on **Y1**. As you press [◀] and [▶], you TRACE along **Y1**, one **X** dot at a time, evaluating **Y1** at each **X**.

   Press [◀] and [▶] until you are on the maximum **Y** value. This is the maximum of **Y1(X)** for the **X** pixels. (There may be a maximum "in between" pixels.)

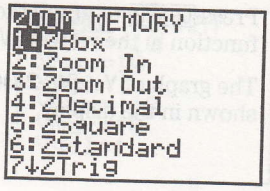


Zooming on the Graph

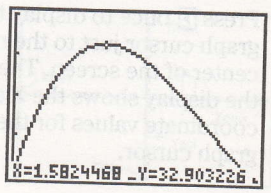
You can magnify the viewing WINDOW around a specific location using the ZOOM instructions to help identify maximums, minimums, roots, and intersections of functions.

1. Press [ZOOM] to display the ZOOM menu.

   This menu is typical of TI-82 menus. To select an item, you may either press the number to the left of the item, or you may press [▼] until the item number is highlighted and then press [ENTER].

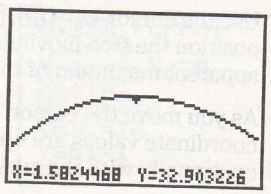


2. To zoom in, press **2**. The graph is displayed again. The cursor has changed to indicate that you are using a ZOOM instruction.

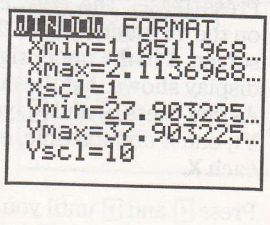


3. Use [◄], [▲], [►], and [▼] to position the cursor near the maximum value on the function and press [ENTER].

   The new viewing WINDOW is displayed. It has been adjusted in both the **X** and **Y** directions by factors of 4, the values for ZOOM factors.



4. Press [WINDOW] to display the new WINDOW settings.



Finding the Calculated

You can use a CALC operation function.

1. Press [2nd] [CALC] to display the CALCULATE menu. Press **4** to maximum.

   The graph is displayed again, prompt for Lower Bound?

2. Use [◄] to trace along the curve to the left of the maximum and press [ENTER].

   A triangle at the top of the scre indicates the selected bound. A prompt is displayed for Upper B

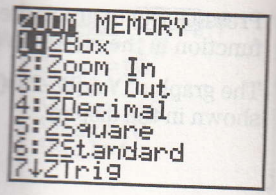
3. Use [►] to trace along the curve to the right of the maximum and press [ENTER].

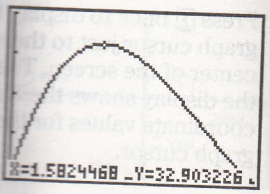
   A triangle at the top of the scree indicates the selected bound. A prompt is displayed for Guess?

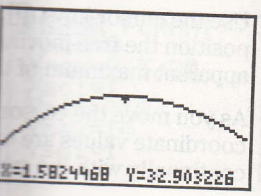
4. Use [◄] to trace to a point near th maximum and press [ENTER]. The is displayed at the bottom of the

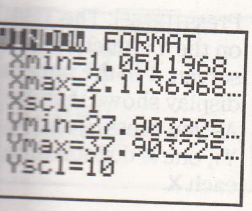
   Note how the values for the calc maximum compared with the ma found with the free-moving curso TRACE, and the table.

nd a specific location using
mums, minimums, roots, and







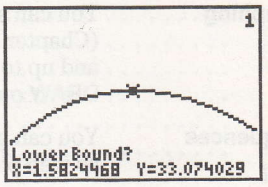


Finding the Calculated Maximum

Use a CALC operation to calculate a local maximum of a

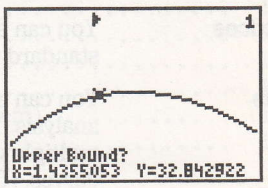
1. [2nd] [CALC] to display the CALCULATE menu. Press **4** to select maximum.

   The graph is displayed again, with a prompt for Lower Bound?



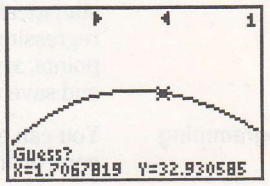
2. Use ◀ to trace along the curve to a point to the left of the maximum and then press [ENTER].

   A triangle at the top of the screen indicates the selected bound. A new prompt is displayed for Upper Bound?



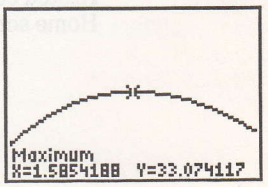
3. Use ▶ to trace along the curve to a point to the right of the maximum and then press [ENTER].

   A triangle at the top of the screen indicates the selected bound. A new prompt is displayed for Guess?



4. Use ◀ to trace to a point near the maximum and press [ENTER]. The answer is displayed at the bottom of the display.

   Note how the values for the calculated maximum compared with the maximums found with the free-moving cursor, TRACE, and the table.



Other Features

Getting Started introduced you to basic calculator operation and the table and function graphing features of the TI-82. The remainder of this guidebook describes these features in more detail and also covers other capabilities of the TI-82.

Graphing	You can store, graph, and analyze up to ten functions (Chapter 3), up to six parametric functions (Chapter 4), and up to six polar functions (Chapter 5). You can use DRAW operations to annotate graphs (Chapter 8).
Sequences	You can generate sequences and graph them over time or as web plots. (Chapter 6)
Tables	You can create function evaluation tables to analyze multiple functions simultaneously. (Chapter 7)
Matrices	You can enter and save up to five matrices and perform standard matrix operations on them. (Chapter 10)
Lists	You can enter and save up to six lists for use in statistical analysis. You also can use lists to evaluate expressions at multiple values simultaneously and to graph a family of curves. (Chapter 11)
Statistics	You can perform one-variable and two-variable list-based statistical analysis, including median-median line and regression analysis, and plot the data as histograms, points, x-y lines, or box-and-whisker plots. You can define and save three statistical plot definitions. (Chapters 12).
Programming	You can enter and save programs that include extensive control and input/output instructions. (Chapter 13)
Split Screen	You can show simultaneously the graph screen and a related editor, such as the Y= screen, table, list editor, or Home screen. (Chapter 9)

This chapter
information a

Chapter
Contents

Turning the T
Setting the Di
The Display .
Entering Exp
TI-82 Edit Ke
Setting Mode
TI-82 Modes
Variable Nam
Storing and R
Last Entry . .
Last Answer .
TI-82 Menus
VARS and Y-
EOS (Equatio
Error Conditi

Chapter 1: Operating the TI-82

This chapter describes the TI-82 and provides general information about its operation.

Chapter Contents

Turning the TI-82 On and Off 1-2
Setting the Display Contrast 1-3
The Display 1-4
Entering Expressions and Instructions 1-6
TI-82 Edit Keys 1-8
Setting Modes 1-9
TI-82 Modes 1-10
Variable Names 1-12
Storing and Recalling Variable Values 1-13
Last Entry 1-14
Last Answer 1-16
TI-82 Menus 1-17
VARS and Y-VARS Menus 1-19
EOS (Equation Operating System) 1-20
Error Conditions 1-22

Turning the TI-82 On and Off

To turn the TI-82 on, press the [ON] key. To turn it off, press and release [2nd] and then press [OFF]. After about five minutes without any activity, APD™ (Automatic Power Down) turns the TI-82 off automatically.

Turning the Calculator On

Press [ON] to turn the TI-82 on.

- If you pressed [2nd] [OFF] to turn the calculator off, the display shows the Home screen as it was when you last used it, and errors are cleared.
- If APD turned the calculator off, the TI-82, including the display, cursor, and any error conditions, will be exactly as you left it.

Turning the Calculator Off

Press and release [2nd] and then press [OFF] to turn the TI-82 off.

- Any error condition is cleared.
- All settings and memory contents are retained by Constant Memory™.

APD™ (Automatic Power Down)

To prolong the life of the batteries, APD turns the TI-82 off automatically after several minutes without any activity. When you press [ON], the TI-82 will be exactly as you left it.

- The display, cursor, and any error conditions are exactly as you left them.
- All settings and memory contents are retained by Constant Memory.

Batteries

The TI-82 uses four AAA alkaline batteries and has a user-replaceable back-up lithium battery. To replace batteries without losing any information stored in memory, follow the directions on page B-2.

Setting the Display Contrast

The brightness and contrast of the display depends on room lighting, battery freshness, viewing angle, and adjustment of the display contrast. The contrast setting is retained in memory when the TI-82 is turned off.

Adjusting the Display Contrast

You can adjust the display contrast to suit your viewing angle and lighting conditions at any time. As you change the contrast setting, the display contrast changes, and a number in the upper right corner indicates the current contrast setting between 0 (lightest) and 9 (darkest).

Note that there are 32 different contrast levels, so each number 0 through 9 represents more than one setting.

To adjust the contrast:

1. Press and release the [2nd] key.
2. Use one of two keys:
   - To increase the contrast, press and hold [▲].
   - To decrease the contrast, press and hold [▼].

Note: If you adjust the contrast setting to zero, the display may become completely blank. If this happens, press and release [2nd] and then press and hold [▲] until the display reappears.

When to Replace Batteries

When the batteries are low, the display begins to dim (especially during calculations), and you must adjust the contrast to a higher setting. If you find it necessary to set the contrast to a setting of 8 or 9, you should replace the four AAA batteries soon.

Note: The display contrast may appear very dark after you change batteries. Press and release [2nd] and then press and hold [▼] to lighten the display.

The Display

The TI-82 displays both text and graphics. Graphics are described in Chapter 3. The TI-82 also can display a split screen, showing graphics and text simultaneously (Chapter 9).

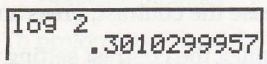
Home Screen

The Home screen is the primary screen of the TI-82, where you enter instructions to be executed and expressions to be evaluated and see the answers.

Displaying Entries and Answers

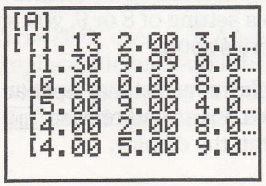
When text is displayed, the TI-82 screen can have up to eight lines of up to 16 characters per line. If all lines of the display are filled, text "scrolls" off the top of the display. If an expression on the Home screen, the Y= editor (Chapter 3), or the program editor (Chapter 13) is longer than one line, it wraps to the beginning of the next line. On numeric editors such as the WINDOW screen (Chapter 3), an expression scrolls to the left and right.

When an entry is executed on the Home screen, the answer is displayed on the right side of the next line.



The MODE settings control the way expressions are interpreted and answers are displayed (page 1-10).

If an answer, such as a list or matrix, is too long to display in its entirety, ellipsis marks (...) are shown at the left or right. Use ▶ and ◀ to scroll the answer and view all of it.



Returning to the Home Screen

To return to the Home screen from any other screen, press 2nd [QUIT].

Display Cursors

In most cases, the appearance of the cursor indicates what will happen when you press the next key.

Cursor	Appearance	Meaning
Entry	Solid blinking rectangle	The next keystroke is entered at the cursor; it types over any character.
INS (insert)	Blinking underline	The next keystroke is inserted in front of the cursor location.
2nd	Blinking ↑ (arrow)	The next keystroke is a 2nd operation.
ALPHA	Blinking A	The next keystroke is an alphabetic character.
"full"	Checkerboard rectangle	You have entered the maximum characters in a name, or memory is full.

If you press [ALPHA] or [2nd] during an insertion, the underline cursor changes to an underlined A or ↑ cursor.

If you press [2nd] or [ALPHA] on a screen on which there is no edit cursor (such as the MODE screen or a graph), ↑ or A appears in the upper right corner.

Graphs and the screens for viewing and editing tables, matrices, and lists have different cursors, which are described in the appropriate chapter.

Busy Indicator

When the TI-82 is calculating or graphing, a moving vertical bar shows in the upper right of the display as a busy indicator. (When you pause a graph or a program, the busy indicator is a dotted bar.)

Entering Expressions and Instructions

On the TI-82, you can enter expressions, which return a value, in most places where a value is required. You enter instructions, which initiate an action, on the Home screen or in the program editor (Chapter 13).

Expressions

An expression is a complete sequence of numbers, variables, functions, and their arguments that evaluate to a single answer. On the TI-82, you enter an expression in the same order that it normally is written. For example, πR^2 is an expression.

Expressions can be used on the Home screen to calculate an answer. In most places where a value is required, expressions may be used to enter a value.

Entering an Expression

To create an expression, enter numbers, variables, and functions from the keyboard and menus. An expression is completed when you press [ENTER], regardless of the cursor location. The entire expression is evaluated according to EOS rules (page 1-20), and the answer displayed.

Most TI-82 functions and operations are symbols with several characters in them. You must enter the symbol from the keyboard or menu, not spell it out. For example, to calculate the log of 45, you must press [LOG] **4 5**. You cannot type in the letters **L O G**. (If you type **LOG**, the TI-82 interprets the entry as implied multiplication of the variables **L**, **O**, and **G**.)

Calculate $3.76 \div (-7.9 + \sqrt{5}) + 2 \log 45$.

3.76 [÷] [(] [(-)] **7.9** [+] [2nd] [√]
5 [)] [+] **2** [LOG] **46**
[ENTER]

```
3.76/(-7.9+√5)+2
log 45
      2.642575252
```

Multiple Entries on a Line

To enter more than one expression or instruction on a line, separate them with a colon (:). They are all stored together in Last Entry (page 1-14).

```
5→A:2→B:A/B
           2.5
```

Entering a Number in Scientific Notation

1. Type the part of the number that precedes the exponent. This value can be an expression.
2. Press [2nd] [EE]. E appears in the display.
3. If the exponent is negative, press [(-)] and then type the exponent, which can be one or two digits.

```
(19/2)E-2
                .095
```

Entering a number in scientific notation does not cause the answers to be displayed in scientific or engineering notation. The display format is detemined by the MODE settings (page 1-10) and the size of the number.

Functions

A function returns a value. For example, ÷, -, +, √, and **log** were the functions in the previous example. In general, the names of functions on the display begin with a lowercase letter. Some functions take more than one argument, which is indicated by a **(** at the end of the name. For example, **min(** requires arguments, **min(5,8)**.

Instructions

An instruction initiates an action. For example, **ClrDraw** is an instruction that clears any drawn elements from a graph. Instructions cannot be used in expressions. In general, the names of instructions begin with a capital letter. Some instructions require more than one argument, which is indicated by a **(** at the end of the name. For example, **Circle(** requires three arguments, **Circle(0,0,5)**.

Interrupting a Calculation

While the busy indicator is displayed, indicating that a calculation or a graph is in progress, you can press [ON] to stop the calculation. (There may be a delay.) Except in graphing, the ERR:BREAK screen is shown.

- To go to where the interruption occurred, select **Goto**.
- To return to the Home screen, select **Quit**.

TI-82 Edit Keys

The arrow keys in the upper right of the keyboard control the movement of the cursor. In normal entry, a keystroke types over the character or characters at the position of the cursor. The [DEL] and [2nd] [INS] keys delete or insert characters.

[▶] or [◀]	Moves the cursor within an expression. These keys repeat.
[▲] or [▼]	Moves the cursor between lines. These keys repeat. • On top line of an expression on the Home screen, [▲] moves the cursor to beginning of expression. • On bottom line of an expression on the Home screen, [▼] moves the cursor to end of expression.
[2nd] [◀]	Moves the cursor to beginning of expression.
[2nd] [▶]	Moves the cursor to end of expression.
[ENTER]	Evaluates an expression or executes an instruction.
[CLEAR]	• On a line with text on the Home screen, clears (blanks) the current line. • On a blank line on the Home screen, clears everything on the Home screen. • In an editor, clears (blanks) expression or value where cursor is located; it does not store a zero.
[DEL]	Deletes character at cursor. This key repeats.
[2nd] [INS]	Inserts characters at underline cursor. To end insertion, press [2nd] [INS] or a cursor-key.
[2nd]	Next keypress is a 2nd operation (the blue operation to the left above a key). The cursor changes to an ↑. To cancel 2nd, press [2nd].
[ALPHA]	Next keypress is an ALPHA character (the gray character to the right above the key). The cursor changes to an A. To cancel ALPHA, press [ALPHA] or a cursor-key.
[2nd] [A-LOCK]	Sets ALPHA-LOCK; each subsequent keypress is an ALPHA character. The cursor changes to an A. To cancel ALPHA-LOCK, press [ALPHA]. Note that prompts for names automatically set the keyboard in ALPHA-LOCK.
[X,T,Θ]	Allows you to enter an **X** in **Func** MODE, a **T** in **Par** MODE, or a θ in **Pol** MODE without pressing [ALPHA] first.

Setting Modes

Modes control how numbers and graphs are displayed and interpreted. MODE settings are retained by Constant Memory™ when the TI-82 is turned off. All numbers, including elements of matrices and lists, are displayed according to the current MODE settings.

Checking MODE Settings

Press [MODE] to display the MODE settings. The current settings are highlighted. The specific MODE settings are described on the following pages.

`Normal Sci Eng`	Numeric display format
`Float 0123466789`	*Number of decimal places*
`Radian Degree`	Unit of angle measure
`Func Par Pol Seq`	*Type of graphing*
`Connected Dot`	Whether to connect graph points
`Sequential Simul`	Whether to plot simultaneously
`FullScreen Split`	Full or split screen

Changing MODE Settings

1. Use [▼] or [▲] to move the cursor to the line of the setting that you want to change. The setting that the cursor is on blinks.
2. Use [▶] or [◀] to move the cursor to the setting that you want.
3. Press [ENTER].

Leaving the MODE Screen

To leave the MODE screen:

- Press the appropriate keys to go to another screen.
- Press [2nd] [QUIT] or [CLEAR] to return to the Home screen.

Setting a MODE from a Program

You can set a MODE from a program by entering the name of the MODE as an instruction; for example, **Func** or **Float**. From a blank line, select the name from the interactive MODE selection screen in the program editor (Chapter 13); the name is copied to the cursor location. The format for fixed decimal setting is **Fix** *n*.

The TI-82 has seven MODE settings. Three are related to how numeric entries are interpreted or displayed and four are related to how graphs appear in the display. Modes are set on the MODE screen (page 1-9).

Normal
Sci
Eng

Notation formats affect only how an answer is displayed on the Home screen. Numeric answers can display with up to 10 digits and a two-digit exponent. You can enter a number in any format.

Normal display format is the way in which we usually express numbers, with digits to the left and right of the decimal, as in **12346.67**.

Sci (scientific) notation expresses numbers in two parts. The significant digits display with one digit to the left of the decimal. The appropriate power of 10 displays to the right of **E**, as in **1.234667E4**.

Eng (engineering) notation is similar to scientific notation. However, the number may have one, two, or three digits before the decimal, and the power-of-10 exponent is a multiple of three, as in **12.34667E3**.

Note: If you select normal display format, but the answer cannot display in 10 digits or the absolute value is less than .001, the TI-82 changes to scientific notation for that answer only.

Float
Fix

Decimal settings affect only how an answer is displayed on the Home screen. They apply to all three notation display formats. You can enter a number in any format.

Float (floating) decimal setting displays up to 10 digits, plus the sign and decimal.

The fixed decimal setting displays the selected number of digits (**0** to **9**) to the right of the decimal. Place the cursor on the number of decimal digits you want and press [ENTER].

ettings. Three are related to
preted or displayed and
s appear in the display.
creen (page 1-9).

ow an answer is displayed on
wers can display with up to
ent. You can enter a number

ay in which we usually
the left and right of the

ses numbers in two parts.
ith one digit to the left of
ower of 10 displays to the

imilar to scientific notation.
e one, two, or three digits
wer-of-10 exponent is a
7E3.

lay format, but the answer
e absolute value is less than
tific notation for that

w an answer is displayed on
all three notation display
r in any format.

displays up to 10 digits,

ys the selected number of
decimal. Place the cursor
you want and press ENTER.

Radian Degree	Angle settings control how the TI-82 interprets angle values in trig functions and polar/rectangular conversions. **Radian** interprets the values as radians. Answers display in radians. **Degree** interprets the values as degrees. Answers display in degrees.
Func Par Pol Seq	**Func** (function) graphing plots functions where **Y** is a function of **X** (Chapter 3). **Par** (parametric) graphing plots relations where **X** and **Y** are functions of **T** (Chapter 4). **Pol** (polar) graphing plots functions where **R** is a function of θ (Chapter 5). **Seq** (sequence) graphing plots sequences (Chapter 6).
Connected Dot	**Connected** draws a line between the points calculated for the selected functions. **Dot** plots only the calculated points of the selected functions.
Sequential Simul	**Sequential** graphing evaluates and plots one function completely before the next function is evaluated and plotted. **Simul** (simultaneous) graphing evaluates and plots all selected functions for a single value of **X** and then evaluates and plots them for the next value of **X**.
FullScreen Split	**FullScreen** uses the entire screen to display a graph or edit screen. **Split** screen displays the current graph on the upper portion of the screen and the Home screen or an editor on the lower portion (Chapter 9).

Variable Names

On the TI-82 you can enter and use several types of data, including real numbers, matrices, lists, functions, stat plots, graph databases, and graph pictures.

Variables and Defined Items

The TI-82 uses preassigned names for variables and other items saved in memory.

Variable type	Names
Real numbers	**A**, **B**, . . . , **Z**, θ
Matrices	[A], [B], [C], [D], [E]
Lists	**L1**, **L2**, **L3**, **L4**, **L5**, **L6**
Functions	**Y1**, **Y2**, . . . , **Y9**, **Y0**
Parametric equations	**X1T**/**Y1T**, . . . , **X6T**/**Y6T**
Polar functions	**r1**, **r2**, **r3**, **r4**, **r5**, **r6**
Sequence functions	**U*n***, **V*n***
Stat plots	**Plot1**, **Plot2**, **Plot3**
Graph databases	**GDB1**, **GDB2**, . . . , **GDB6**
Graph pictures	**Pic1**, **Pic2**, . . . , **Pic6**
System variables	**Xmin**, **Xmax**, and others

Programs have user-defined names also and share memory with variables. Programs are entered and edited from the program editor (Chapter 13).

You can store to matrices (Chapter 10), lists (Chapter 11), system variables such as **Xmax** (Chapter 3) or **TblMin** (Chapter 7), and all functions (Chapters 3, 4, 5, and 6) from the Home screen or from a program. You can store to matrices (Chapter 10), lists (Chapter 12), and functions (Chapter 3) from editors. You can store to a matrix element (Chapter 10) or a list element (Chapter 11). Graph databases and pictures are stored and recalled using instructions from the DRAW menu (Chapter 8).

nd use several types of data,
rices, lists, functions, stat
graph pictures.

mes for variables and other

mes
3, . . . , Z, θ
[B], [C], [D], [E]
L2, L3, L4, L5, L6
Y2, . . . , Y9, Y0
/Y1T, . . . , X6T/Y6T
2, r3, r4, r5, r6
Vn
t1, Plot2, Plot3
B1, GDB2, . . . , GDB6
, Pic2, . . . , Pic6
n, Xmax, and others

mes also and share memory
ntered and edited from the

pter 10), lists (Chapter 11),
(Chapter 3) or **TblMin**
Chapters 3, 4, 5, and 6) from
gram. You can store to
apter 12), and functions
an store to a matrix element
Chapter 11). Graph
ed and recalled using
enu (Chapter 8).

Storing and Recalling Variable Values

Values are stored to and recalled from memory using variable names. When an expression containing the name of a variable is evaluated, the value of the variable at that time is used.

Storing Values in a Variable

You can store a value to a variable from the Home screen or a program using the [STO▸] key. Begin on a blank line.

1. Enter the value that you want to store (which can be an expression).
2. Press [STO▸]. The symbol → is copied to the cursor location.
3. Press [ALPHA], then the letter of the variable to which you want to store the value.
4. Press [ENTER]. If you entered an expression, it is evaluated. The value is stored in the variable.

```
5+8^3→Q
                517
```

Displaying a Variable Value

To display the value of a variable, enter the name on a blank line on the Home screen, and press [ENTER].

RCL (Recall)

You can copy variable contents to the current cursor location. Press [2nd] [RCL], and then enter the name of the variable in one of the following ways:

- Press [ALPHA] and then the letter of the variable.
- Press [2nd] and the name of the list.
- Press [MATRX] and select the name of the matrix.
- Press [2nd] [Y-VARS] and select the type and name of the function.
- Press [PRGM] and select the name of the program (in the program editor only).

You can edit the characters copied to the expression without affecting the value in memory.

Note: When an error (such as a variable with no assigned value) occurs on the RCL line, the name is cleared automatically for you to enter the correct name. To leave RCL without recalling a value, press [CLEAR].

Last Entry

When you press [ENTER] on the Home screen to evaluate an expression or execute an instruction, the expression or instruction is stored in a storage area called Last Entry, which you can recall. When you turn the TI-82 off, Last Entry is retained in memory.

Using Last Entry

You can recall Last Entry and edit it from the Home screen or any editor. Press [2nd] [ENTRY]. On the Home screen or a numeric editor, the current line is cleared and the Last Entry is copied to the line. The cursor is positioned at the end of the entry. In the program editor, the Last Entry is inserted at the cursor location. Because the TI-82 updates the Last Entry storage area only when [ENTER] is pressed, you can recall the previous entry even if you have begun entering the next expression. However, when you recall Last Entry, it replaces what you have typed.

5 [+] 7
[ENTER]
[2nd] [ENTRY]

```
5+7
          12
5+7
```

Multiple Entries on a Line

To enter more than one expression or instruction on a line, separate them with a colon (:). They are all stored together in Last Entry (page 1-14).

If the previous entry contained more than one expression or instruction, separated with a colon (page 1-7), they all are recalled. You can recall all entries on a line, edit any of them, and then execute all of them.

Using the equation $A=\pi r^2$, use trial and error to find the radius of a circle that covers 200 square centimeters. Use 8 as your first guess.

8 [STO▸] [ALPHA] R [2nd] [:]
[2nd] [π] [ALPHA] R [x²]
[ENTER]
[2nd] [ENTRY]

```
8→R:πR²
      201.0619298
8→R:πR²
```

[2nd] [◂] 7 [2nd] [INS] .95
[ENTER]

```
8→R:πR²
      201.0619298
7.95→R:πR²
      198.5565097
```

Continue until the answer is as accurate as you want.

me screen to evaluate
ruction, the expression
ge area called
When you turn the TI-82
ory.

t from the Home screen
n the Home screen or a
cleared and the
cursor is positioned at
editor, the Last Entry is
ause the TI-82 updates
en [ENTER] is pressed, you
f you have begun
ever, when you recall
e typed.

```
                  12
■
```

or instruction on a line,
y are all stored together

e than one expression
on (page 1-7), they all
es on a line, edit any of

and error to find the
uare centimeters. Use 8

```
πR²
 201.0619298
πR²■
```

```
πR²
 201.0619298
→R:πR²
 198.5565097
```

rate as you want.

Reexecuting the Previous Entry

To execute Last Entry press [ENTER] on a blank line on the Home screen; the entry does not display again.

0 [STO▸] [ALPHA] N
[ENTER]
[ALPHA] N [+] 1 [STO▸] [ALPHA] N
[2nd] [:] [ALPHA] N [x^2] [ENTER]
[ENTER]
[ENTER]

```
0→N
                  0
N+1→N:N²
                  1
                  4
                  9
```

Accessing a Previous Entry

The TI-82 retains as many of the previous entries as is possible (up to a total of 128 bytes) in the Last Entry storage area. You can access those entries by continuing to press [2nd] [ENTRY]. (If a single entry is more than 128 bytes, it is retained for Last Entry, but it cannot be placed in the Last Entry storage area.)

1 [STO▸] [ALPHA] A
[ENTER]
2 [STO▸] [ALPHA] B
[ENTER]
3 [STO▸] [ALPHA] C
[ENTER]
[2nd] [ENTRY]

```
1→A
                  1
2→B
                  2
3→C
                  3
3→C■
```

Each time you press [2nd] [ENTRY], the current line is overwritten. If you press [2nd] [ENTRY] after displaying the oldest item, the newest item is displayed.

[2nd] [ENTRY]

```
1→A
                  1
2→B
                  2
3→C
                  3
2→B■
```

Last Answer

When an expression is evaluated successfully from the Home screen or from a program, the TI-82 stores the answer to a variable, Ans (Last Answer). Ans may be a real number, a list, or a matrix. When you turn the TI-82 off, the value in Ans is retained in memory.

Using Ans in an Expression

You can use the variable **Ans** to represent the last answer in most places. Press 2nd [ANS] and the variable name **Ans** is copied to the cursor location. When the expression is evaluated, the TI-82 uses the value of **Ans** in the calculation.

Calculate the area of a garden plot 1.7 meters by 4.2 meters. Then calculate the yield per acre if the plot produces a total of 147 tomatoes.

1.7 × **4.2**
ENTER
147 ÷ 2nd [ANS]
ENTER

```
1.7*4.2
                7.14
147/Ans
        20.58823529
```

Continuing an Expression

You can use the value in **Ans** as the first entry in the next expression without entering the value again or pressing 2nd [ANS]. On the blank line on the Home screen, enter the function. The TI-82 "types" the variable name **Ans** followed by the function.

5 ÷ **2**
ENTER
× **9.9**
ENTER

```
5/2
                2.5
Ans*9.9
               24.75
```

Storing Answers

To store an answer, store **Ans** to a variable before you evaluate another expression.

Calculate the area of a circle of radius 5 meters. Then calculate the volume of a cylinder of radius 5 meters and height 3.3 meters and store in the variable **V**.

2nd [π] **5** x^2
ENTER
× **3.3**
ENTER
STO▶ ALPHA **V**
ENTER

```
π5²
          78.53981634
Ans*3.3
         259.1813939
Ans→V
         259.1813939
```

uated successfully from the
ram, the TI-82 stores the
ast Answer). Ans may be a
ix. When you turn the
retained in memory.

to represent the last answer
S] and the variable name **Ans**
n. When the expression is
value of **Ans** in the

plot 1.7 meters by 4.2
ld per acre if the plot
es.

```
1.7*4.2
                7.14
147/Ans
        20.58823529
```

s the first entry in the next
e value again or pressing
the Home screen, enter the
variable name **Ans** followed

```
5/2
                2.5
Ans*9.9
               24.75
```

to a variable before you

f radius 5 meters. Then
der of radius 5 meters and
he variable **V**.

```
5²
       78.53981634
ns*3.3
      259.1813939
ns→V
      259.1813939
```


To leave the keyboard uncluttered, the TI-82 uses full-screen menus to access many additional operations. The use of specific menus is described in the appropriate chapters.

Moving from One Menu to Another

A menu key may access more than one menu. The names of the menus appear on the top line. The current menu is highlighted and the items in that menu are displayed.

Use ▶ or ◀ to move the cursor to a different menu.

Selecting an Item from a Menu

The number of the current item is highlighted. If there are more than seven items on the menu, a ↓ appears on the last line in place of the : (colon). Menu items that end in ... (ellipsis marks) access another menu.

There are two methods of selecting from a menu.

- Press the number of the item you want to select.
- Use ▼ and ▲ to move the cursor to the item you want to select and then press [ENTER].

Leaving a Menu without Making a Selection

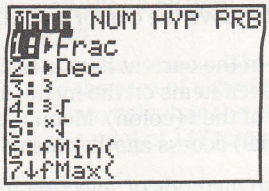
After you make a selection from a menu, you usually are returned to the screen where you were.

To leave a menu without making a selection:

- Press [2nd] [QUIT] to return to the Home screen.
- Press [CLEAR] to return to the screen where you were.
- Display a different menu by pressing the appropriate key, such as [MATH].
- Select another screen by pressing the appropriate key, such as [WINDOW].

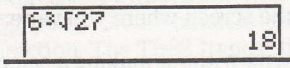
Calculate $6\sqrt[3]{27}$.

1. *Press* **6**. *Press* MATH *to display the MATH menu.*



2. To select $\sqrt[3]{}$, you may either press **4** or press ▼ ▼ ▼ ENTER.

3. Press **27** and then press ENTER to evaluate the expression.



VARS and Y-VARS Menus

Occasionally you may want to access the names of functions and system variables to use in an expression or to store to them directly. Use the VARS or Y-VARS menus to access the names of variables such as Xmin and functions such Y_1.

VARS Menu

The VARS menu accesses the names of WINDOW variables such as **Xmin** and **Tstep**, the user-defined ZOOM variables such as **ZXmin**, graph databases and graph pictures such as **GDB1** and **Pic2**, statistics variables such as $\bar{x}$, **RegEQ** and Q_1, and table variables such as **TblMin**.

Press [VARS] to display the VARS menu. Some of the items access more than one menu of variable names.

VARS	
1: Window...	Names of X/Y, T/θ, U/V variables
2: Zoom...	Names of ZT/ZY, ZT/Zθ, ZU variables
3: GDB...	Names of **GDB***n* variables
4: Picture...	Names of **Pic***n* variables
5: Statistics...	X/Y, Σ, EQ, BOX, PTS variables
6: Table...	Names of Table variables

Y-VARS Menu

The Y-VARS menu accesses the names of functions and the instructions to select or deselect functions from a program or the Home screen.

Press [2nd] [Y-VARS] to display the Y-VARS menu.

Y-VARS	
1: Function...	Displays names of **Y***n* functions
2: Parametric...	Displays names of **X**T*n*, **Y**T*n* functions
3: Polar...	Displays names of **r***n* functions
4: Sequence...	Displays names of **U***n*, **V***n* functions
5: On/Off...	Lets you select/deselect functions

Accessing a Name from a VARS or Y-VARS Menu

1. Press [VARS] or [2nd] [Y-VARS]. The VARS or Y-VARS menu is displayed.
2. Select the type of name you want; **Picture...** or **Polar...**, for example.
   - In VARS, use [▶] or [◀] to move to the menu you want, if necessary.
   - In Y-VARS, a single menu is displayed.
3. Select the name you want from the menu. It is copied to the cursor location.

EOS (Equation Operating System)

The Equation Operating System (EOS™) defines the order in which functions in expressions are entered and evaluated on the TI-82. EOS lets you enter numbers and functions in a simple, straightforward sequence.

Order of Evaluation

A function returns a value. EOS evaluates the functions in an expression in the following order:

1	Functions that are entered after the argument, such as ^{2}, $^{-1}$, **!**, °, **r**, **T**, and conversions.
2	Powers and roots, such as 2^5 or $5\sqrt[x]{32}$.
3	Implied multiplication where the second argument is a number, variable name, list, or matrix or begins with an open parenthesis, such as **4A**, **3[B]**, **(A+B)4**, or **4(A+B)**.
4	Single-argument functions that precede the argument, such as negation, √, **sin**, or **log**.
5	Implied multiplication where the second argument is a multiargument function or a single-argument function that precedes the argument, such as **2nDeriv(A^2,A,6)** or **Asin 2**.
6	Permutations (**nPr**) and combinations (**nCr**).
7	Multiplication and division.
8	Addition and subtraction.
9	Relational functions, such as **>** or ≤.
10	Logic operator **and**.
11	Logic operators **or** and **xor**.

Within a priority group, EOS evaluates functions from left to right. However, two or more single-argument functions that precede the same argument are evaluated from right to left. For example, **sin fPart ln 8** is evaluated as **sin(fPart(ln 8))**.

Calculations within a pair of parentheses are evaluated first. Multiargument functions, such as **nDeriv(A^2,A,6)**, are evaluated as they are encountered.

tem (EOS™) defines the
xpressions are entered and
lets you enter numbers and
ıtforward sequence.

S evaluates the functions in
order:

tered after the argument,
and conversions.

ch as 2^5 or $5^x\sqrt{32}$.

n where the second
, variable name, list, or
an open parenthesis, such
r 4(A+B).

tions that precede the
gation, √, **sin**, or **log**.

n where the second
gument function or a single-
t precedes the argument,
,6) or **Asin 2**.

d combinations (**nCr**).

ision.

ion.

uch as > or ≤.

xor.

aluates functions from left
single-argument functions
t are evaluated from right to
is evaluated as

entheses are evaluated
uch as **nDeriv(A²,A,6)**, are
ed.

Implied Multiplication

The TI-82 recognizes implied multiplication. For example, it understands **2π**, **4 sin 46**, **5(1+2)**, and **(2*5)7** as implied multiplication.

Parentheses

All calculations inside a pair of parentheses are completed first. For example, in the expression **4(1+2)**, EOS first evaluates the portion inside the parentheses, **1+2**, and then multiplies the answer, **3**, by **4**.

You can omit any right (close) parenthesis at the end of an expression. All "open" parenthetical elements are closed automatically at the end of an expression and preceding the → (store) or display conversion instructions.

Note: If the name of a list or matrix is followed by an open parenthesis, it does not indicate implied multiplication. It is used to access specific elements in the list (Chapter 11) or matrix (Chapter 10).

Negation

To enter a negative number, use the negation function. Press [(-)] and then enter the number. On the TI-82, negation is in the fourth group in the EOS hierarchy. Functions in the first group, such as squaring, are evaluated before negation.

For example, **-X²** is a negative number (or 0); **-9²** is **-81**. Use parentheses to square a negative number: **(-9)²**.

```
-2²
                  -4
(-2)²
                   4
-A²
                  -4
(-A)²
                   4
```

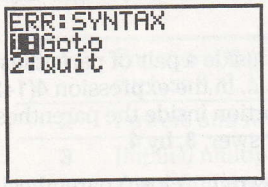
Note: Use the [−] key for subtraction and the [(-)] key for negation. If you press [−] to enter a negative number, as in **9 [×] [−] 7**, or if you press [(-)] to indicate subtraction, as in **9 [(-)] 7**, it is an error. If you press [ALPHA] **A** [(-)] [ALPHA] **B**, it is interpreted as implied multiplication (**A*-B**).

Error Conditions

The TI-82 detects any errors at the time it evaluates an expression, executes an instruction, plots a graph, or stores a value. Calculations stop and an error message with a menu displays immediately. Error codes and conditions are described in detail in Appendix B.

Diagnosing an Error

If the TI-82 detects an error, it displays the error screen.



The top line indicates the general type of error, such as SYNTAX or DOMAIN. Additional information about each error message is in Appendix B.

- If you select **Goto**, the cursor is displayed at the location where the error was detected.

  Note: If a syntax error was detected in the contents of a Y= function during program execution, this option returns the user to the Y= editor, not the program.

- If you select **Quit** or press [2nd] [QUIT] or [CLEAR], you return to the Home screen.

Correcting an Error

1. Note the type of the error.
2. Select **Goto**, if that option is available, and look at the expression for syntax errors, especially at and in front of the cursor location.
3. If the error in the expression is not readily apparent, turn to Appendix B and read the information about the error message.
4. Correct the expression.

Chapter 2: Math, Angle, and Te

This chapter describes m operations that are avail commonly used functio keyboard; others are ac menus.

Chapter Contents

Getting Started: Lottery
Keyboard Math Operatio
MATH MATH Operations
MATH NUM (Number) O
MATH HYP (Hyperbolic)
MATH PRB (Probability)
ANGLE Operations . . .
TEST TEST (Relational)
TEST LOGIC (Boolean)

ors at the time it evaluates an instruction, plots a graph, or ns stop and an error message nediately. Error codes and in detail in Appendix B.

r, it displays the error screen.

eneral type of error, such as ional information about each ix B.

ursor is displayed at the r was detected.

vas detected in the contents of gram execution, this option = editor, not the program.

ss 2nd [QUIT] or CLEAR, you en.

r.

n is available, and look at the rors, especially at and in front

sion is not readily apparent, read the information about the

Chapter 2: Math, Angle, and Test Operations

This chapter describes math, angle, and relational operations that are available on the TI-82. The most commonly used functions are accessed from the keyboard; others are accessed through full-screen menus.

Chapter Contents

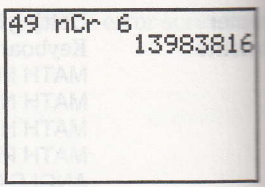
Getting Started: Lottery Chances	2-2
Keyboard Math Operations	2-3
MATH MATH Operations	2-5
MATH NUM (Number) Operations	2-9
MATH HYP (Hyperbolic) Operations	2-11
MATH PRB (Probability) Operations	2-12
ANGLE Operations	2-13
TEST TEST (Relational) Operations	2-15
TEST LOGIC (Boolean) Operations	2-16

Getting Started: Lottery Chances

Getting Started is a fast-paced introduction. Read the chapter for details.

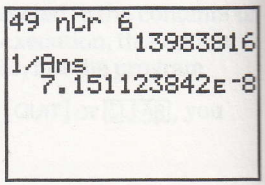
Suppose you want to enter a lottery where 6 numbers will be drawn out of 49. To win, you must pick all 6 numbers (in any order). What is the probablility of winning if you buy one ticket? What is the probability of winning if you buy five tickets?

1. Determine the number of combinations possible. On the Home screen, press **49** to enter the total number of items. Press [MATH] [◀] to display the MATH PRB menu. Press **3** or [▼] [▼] [ENTER] to select **nCr**. Press **6** to enter the number of items selected.

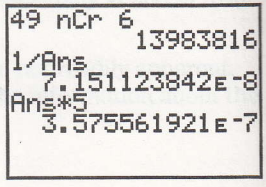


2. Press [ENTER] to evaluate the expression. This is the total number of possible combinations of 6 numbers drawn from a set of 49 numbers. With one ticket, you have one chance in 13,983,816 of winning.

3. To calculate the probability of winning with one ticket, press **1** [÷] [2nd] [ANS] [ENTER]. The answer is expressed in scientific notation on the TI-82 because it is so small. The decimal equivalent is 0.00000007151123842.

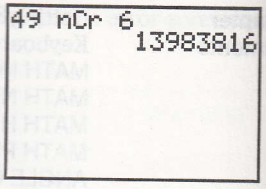


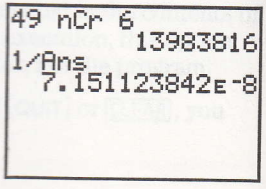
4. To calculate the probability of winning with five tickets, press [×] **5** [ENTER]. Again, the answer is too small to display in fixed notation. The decimal equivalent is 0.0000003575561921.

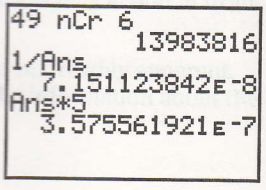


uction. Read the chapter for details.

here 6 numbers will be drawn out
bers (in any order). What is the
ticket? What is the probability of





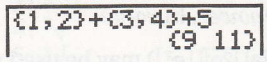


Keyboard Math Operations

The most commonly used math functions are on the keyboard.

Using Lists with Functions

Functions that are valid for lists return a list calculated on an element-by-element basis. If two lists are used in the same expression, they must be the same length.



+ (Add) – (Subtract) * (Multiply) / (Divide)

+ (addition [+]), **–** (subtraction [−]), **∗** (multiplication [×]), and **/** (division [÷]) may be used with numbers, expressions, lists, or matrices (Chapter 10).

valueA+*valueB*, *valueA*–*valueB*, *valueA*∗*valueB*, *valueA*/*valueB*

Trig Functions

The trigonometric functions may be used with numbers, expressions, or lists. They are interpreted according to the current **Radian/Degree** MODE setting. For example, **sin 30** in **Radian** MODE returns **-.9880316241**; in **Degree** MODE it returns **.5**.

sin *value*, **cos** *value*, **tan** *value*

sin^{-1}, **cos**$^{-1}$, and **tan**$^{-1}$ are the inverse trig functions (arcsine, arccosine, and arctangent).

sin^{-1} *value*, **cos**$^{-1}$ *value*, **tan**$^{-1}$ *value*

^ (Power) ² (Square) √ (Square Root)

^ (power [^]), **²** (squared [x²]), and **√** (square root [2nd] [√]) may be used with numbers, expressions, lists, or matrices (Chapter 10).

value^*power*, *value*^{2}, √*value*

Note: Raising a negative number to a noninteger power can result in a complex number, which returns an error.

$^{-1}$ (Inverse)

$^{-1}$ (inverse [x⁻¹]) may be used with numbers, expressions, lists, or matrices (Chapter 10).The multiplicative inverse is the equivalent of the reciprocal, 1/x.

value^{-1}

log
10^
ln

log (logarithm [LOG]), **10^** (power of ten [2nd] [10^x]), and **ln** (natural log [2nd] [ln]) may be used with a number, expression, or list.

log *value*, **10^***power*, **ln** *value*

e^

e^ (exponential [2nd] [e^x]) may be used with a number, expression, or list. **e^** returns the constant e raised to a power. **e^1** returns the value of the constant e.

e^*power*

```
e^5
        148.4131591
e^1
        2.718281828
```

- (Negation)

- (negation [(-)]) returns the negative of a number, expression, list, or matrix (Chapter 10). The narrow negation symbol (**-**) distinguishes negation from the subtraction or minus [−] (–).

-*value*

EOS rules (Chapter 1) determine when negation is evaluated. For example, **-A²** returns a negative number (squaring is evaluated before negation according to EOS rules). Use parentheses to square a negated number, **(-A)²**.

```
2→A:{-A²,(-A)²,-
2²,(-2)²}
        {-4 4 -4 4}
```

abs

abs (absolute value) returns the absolute value of a number, expression, list, or matrix (Chapter 10).

abs *value*

π (Pi)

Pi is stored as a constant in the TI-82. Press [2nd] [π] to copy the symbol π to the cursor location. The number 3.1415926535898 is used internally in calculations.

To display the MAT
select an item from
cursor location. Fu
list calculated on a

MATH MATH
Menu

```
MATH  NUM HYP P
1:▶Frac
2:▶Dec
3:³
4:³√
5:ˣ√
6:fMin(
7:fMax(
8:nDeriv(
9:fnInt(
0:solve(
```

▶Frac

▶**Frac** (display as fr
rational equivalent.
expression, list, or
denominator is mo
equivalent is return
expression.

expression▶**Frac**

```
1/2+1/3▶Frac
```

▶Dec

▶**Dec** (display as de
form. ▶**Dec** is valid

expression▶**Dec**

```
1/2+1/3▶Frac

Ans▶Dec
        .833333
```

MATH MATH Operations

To display the MATH MATH menu, press [MATH]. When you select an item from the menu, the name is copied to the cursor location. Functions that are valid for lists return a list calculated on an element-by-element basis.

MATH MATH menu

```
MATH  NUM HYP PRB
1:▶Frac
2:▶Dec
3:³
4:³√
5:ˣ√
6:fMin(
7:fMax(
8:nDeriv(
9:fnInt(
0:solve(
```

1:▶Frac	Display answer as fraction
2:▶Dec	Display answer as decimal
3:³	Cube
4:³√	Cube root
5:ˣ√	n^{th} root
6:fMin(	Minimum of a function
7:fMax(	Maximum of a function
8:nDeriv(	Numerical derivative
9:fnInt(	Function integral
0:solve(	Solution (root) of a function

▶Frac

▶Frac (display as fraction) displays an answer as the rational equivalent. The answer may be a number, expression, list, or matrix. If it cannot be simplified or the denominator is more than three digits, the decimal equivalent is returned. **▶Frac** is valid only at the end of an expression.

expression▶**Frac**

```
1/2+1/3▶Frac
                5/6
```

▶Dec

▶Dec (display as decimal) displays an answer in decimal form. **▶Dec** is valid only at the end of an expression.

expression▶**Dec**

```
1/2+1/3▶Frac
                5/6
Ans▶Dec
      .8333333333
```

^{3} (Cube)

^{3} (cube, MATH MATH item 3) returns the cube of a number, expression, list, or square matrix (Chapter 10).

value^3

```
{2,3,4,5}^3
    {8 27 64 125}
```

$\sqrt[3]{}$ (Cube Root)

$\sqrt[3]{}$ (cube root, MATH MATH item 4) returns the cube root of a number, expression, or list.

$\sqrt[3]{}$*value*

```
³√{8,27,64,125}
      {2 3 4 5}
```

$\sqrt[x]{}$ (Root)

$\sqrt[x]{}$ (root, MATH MATH item 5) returns the n^{th} real root of a number, expression, or list.

n^{th}*root*$\sqrt[x]{}$*value*

```
5ˣ√32
                2
```

fMin(
fMax(

fMin((function minimum, MATH MATH item 6) and **fMax(** (function maximum, MATH MATH item 7) return the value at which the minimum or maximum value of *expression* with respect to *variable* occurs, between *lower* and *upper* values for *variable*. *lower* must be less than *upper*. **fMin(** and **fMax(** are not valid in *expression*. The accuracy is controlled by *tolerance* (optional; if not specified, 1E-5 is used). If there is no finite minimum or maximum in the interval, usually (depending on *expression*) an error occurs.

fMin(*expression*,*variable*,*lower*,*upper*) or
fMin(*expression*,*variable*,*lower*,*upper*,*tolerance*)

```
fMin(sin A,A,-π,
π)
    -1.570797171
```


nDeriv(

nDeriv((numerical de
an approximate deriv
variable, given the va
derivative, and ε (opti
used).

nDeriv(*expression*,va
nDeriv(*expression*,va

nDeriv(uses the symm
which approximates t
slope of the secant lin

(*value*–ε, *expression*(
(*value*+ε,*expression*(

As ε gets smaller, the
accurate.

```
nDeriv(A^3,A,5,
01)
                75.00
nDeriv(A^3,A,5,
0001)
```

nDeriv(can be used o
method, **nDeriv(** can n
nondifferentiable poin

fnInt(

fnInt((function integr
numerical integral (Ga
with respect to *variab*
a *tolerance* (optional;

fnInt(*expressio*n,*vari*
fnInt(*expressio*n,*vari*

```
fnInt(A²,A,0,1)
      .333333333
```

fnInt(is not valid in ex

urns the cube of a number,
(Chapter 10).

4) returns the cube root

urns the n^{th} real root of a

MATH item 6) and
MATH item 7) return the
aximum value of
le occurs, between *lower*
er must be less than
id in *expression*. The
e (optional; if not
no finite minimum or
depending on

pper) or
pper,*tolerance*)

nDeriv(

nDeriv((numerical derivative, MATH MATH item 8) returns an approximate derivative of *expression* with respect to *variable*, given the *value* at which to calculate the derivative, and ε (optional; if none is specified, 1E-3 is used).

nDeriv(*expression*,*variable*,*value*) or
nDeriv(*expression*,*variable*,*value*,ε)

nDeriv(uses the symmetric difference quotient method, which approximates the numerical derivative value as the slope of the secant line through the points:

(*value*–ε, *expression*(*value*–ε)) and
(*value*+ε,*expression*(*value*+ε))

As ε gets smaller, the approximation usually gets more accurate.

```
nDeriv(A^3,A,5,.
01)
                75.0001
nDeriv(A^3,A,5,.
0001)
                     75
```

nDeriv(can be used once in *expression*. Because of the method, **nDeriv(** can return a false derivative value at a nondifferentiable point.

fnInt(

fnInt((function integral, MATH MATH item 9) returns the numerical integral (Gauss-Kronrod method) of *expression* with respect to *variable*, given *lower* limit, *upper* limit, and a *tolerance* (optional; if none is specified, 1E-5 is used).

fnInt(*expression*,*variable*,*lower*,*upper*) or
fnInt(*expression*,*variable*,*lower*,*upper*,*tolerance*)

```
fnInt(A²,A,0,1)
          .3333333333
```

fnInt(is not valid in *expression*.

solve(

solve((MATH MATH item 0) returns a solution (root) of *expression* for *variable*, given an initial *guess*, a *lower* bound, and an *upper* bound within which a solution is sought (optional, if not specified, *lower*=-1E99 and *upper*=1E99).

solve(*expression*,*variable*,*guess*) or
solve(*expression*,*variable*,*guess*,{*lower*,*upper*})

expression is assumed equal to zero. The value of *variable* in memory will not be updated. *guess* may be a value or a list of two values. Values must be stored to every variable in *expression*, except *variable*, before *expression* is evaluated. *lower* and *upper* are entered in list format.

```
solve(Q^3-125,Q,
4,{0,100})
                5
```

Controlling the Solution for solve(

The TI-82 solves equations through an iterative process. To control that process, you should provide a close bound of the solution and at least one initial guess (which must be within the bounds). This will help to:

- Find a solution.
- Define which solution you want for equations with multiple solutions.
- Find the solution more quickly.

To display the
you select an it
the cursor loca
return a list cal

```
MATH NUM HYP
1:round(
2:iPart
3:fPart
4:int
5:min(
6:max(
```

round(returns a
rounded to #deci
is rounded to 10

round(*value*,#de
round(*value*)

```
round(π,3)
```

iPart (integer par
number, expressi

iPart *value*

fPart (fractional p
a number, expres

fPart *value*

```
iPart -23.45
fPart -23.45
```

MATH NUM (Number) Operations

To display the MATH NUM menu, press MATH ▶. When you select an item from the menu, the name is copied to the cursor location. Functions that are valid for lists return a list calculated on an element-by-element basis.

MATH NUM menu

```
MATH  NUM  HYP PRB
1:round(        Round
2:iPart         Integer part
3:fPart         Fractional part
4:int           Greatest integer
5:min(          Minimum value
6:max(          Maximum value
```

round(

round(returns a number, expression, list, or matrix rounded to *#decimals* (≤ 9). If *#decimals* is omitted, *value* is rounded to 10 digits.

round(*value*,*#decimals*)
round(*value*)

```
round(π,3)
                3.142
```

iPart

iPart (integer part) returns the integer part or parts of a number, expression, list, or matrix (Chapter 10).

iPart *value*

fPart

fPart (fractional part) returns the fractional part or parts of a number, expression, list, or matrix (Chapter 10).

fPart *value*

```
iPart -23.45
                -23
fPart -23.45
                -.45
```

int

int (greatest integer) returns the largest integer less than or equal to a number, expression, list, or matrix. The value is the same as **iPart** for nonnegative numbers and negative integers, but one integer less than **iPart** for negative noninteger numbers.

int *value*

```
int -23.45
                -24
```

min(
max(

min((minimum value) returns the smaller of *valueA* or *valueB* or the smallest element in a list. If two lists are compared, it returns a list of the smaller of each pair of elements.

max((maximum value) returns the larger of *valueA* or *valueB* or the largest element in a list. If two lists are compared, it returns a list of the larger of each pair of elements.

min(*valueA*,*valueB*) or **max(***valueA*,*valueB*)
min(*list*) or **max(***list*)
min(*listA*,*listB*) or **max(***listA*,*listB*)

```
max(-7,9/2)
                4.5
max({1,2,3})
                  3
max({1,2,3},{3,2
,1})
          {3 2 3}
```

Note: The **min(** and **max(** functions on the MATH NUM menu are the same as the **min(** and **max(** functions on the LIST MATH menu.

To display the MATH HYP m
you select an item from the
the cursor location. Functio
return a list calculated on a

MATH HYP
Menu

```
MATH NUM  HYP PRB
1:sinh      Hype
2:cosh      Hype
3:tanh      Hype
4:sinh⁻¹    Hype
5:cosh⁻¹    Hype
6:tanh⁻¹    Hype
```

sinh
cosh
tanh

sinh, **cosh**, and **tanh** are the
are valid for lists.

sinh *value*

```
sinh .5
     .5210953055
```

sinh⁻¹
cosh⁻¹
tanh⁻¹

sinh⁻¹, **cosh⁻¹**, and **tanh⁻¹** a
hyperbolic arccosine, and hy
respectively. They are valid

sinh⁻¹ *value*

```
sinh⁻¹ {0,1}
  {0 .881373587}
```

the largest integer less than
ssion, list, or matrix. The value
egative numbers and negative
s than **iPart** for negative

s the smaller of *valueA* or
nt in a list. If two lists are
the smaller of each pair of

ns the larger of *valueA* or
t in a list. If two lists are
the larger of each pair of

valueA,*valueB*)

,*listB*)

ctions on the MATH NUM
(and **max(** functions on the

MATH HYP (Hyperbolic) Operations

To display the MATH HYP menu, press MATH ▶ ▶. When you select an item from the menu, the name is copied to the cursor location. Functions that are valid for lists return a list calculated on an element-by-element basis.

MATH HYP menu

```
MATH NUM  HYP  PRB
1:sinh          Hyperbolic sine
2:cosh          Hyperbolic cosine
3:tanh          Hyperbolic tangent
4:sinh⁻¹        Hyperbolic arcsine
5:cosh⁻¹        Hyperbolic arccosine
6:tanh⁻¹        Hyperbolic arctangent
```

sinh
cosh
tanh

sinh, **cosh**, and **tanh** are the hyperbolic functions. They are valid for lists.

sinh *value*

```
sinh .5
     .5210953055
```

sinh⁻¹
cosh⁻¹
tanh⁻¹

sinh⁻¹, **cosh⁻¹**, and **tanh⁻¹** are the hyperbolic arcsine, hyperbolic arccosine, and hyperbolic arctangent functions, respectively. They are valid for lists.

sinh⁻¹ *value*

```
sinh⁻¹ {0,1}
  {0 .881373587}
```

MATH PRB (Probability) Operations

To display the MATH PRB menu, press [MATH] [◀]. When you select an item from the menu, the name is copied to the cursor location. Functions that are valid for lists return a list calculated on an element-by-element basis.

MATH PRB Menu

```
MATH NUM HYP  PRB
1:rand        Random number generator
2:nPr         Number of permutations
3:nCr         Number of combinations
4:!           Factorial
```

rand

rand (random number) generates and returns a random number greater than 0 and less than 1. A random number is generated from a seed value. To control a random number sequence, first store an integer seed value in **rand**. If you store **0** to **rand**, the TI-82 uses the factory-set seed value. When you reset the TI-82, **rand** is set to the factory seed.

```
0→rand:rand*3
      2.830792207
```

nPr

nPr (number of permutations) returns the number of permutations of *items* taken *number* at a time. *items* and *number* must be nonnegative integers.

items **nPr** *number*

nCr

nCr (number of combinations) returns the number of combinations of *items* taken *number* at a time. *items* and *number* must be nonnegative integers.

items **nCr** *number*

```
5 nPr 2
                20
5 nCr 2
                10
```

! (Factorial)

! (factorial) returns the factorial of a positive integer between 0 and 69.

value!

```
6!
               720
```


ANGLE Operations

To display the ANG ANGLE menu displ When you select a copied to the cursc interpreted accordi setting.

ANGLE Menu

```
ANGLE
1:°
2:'
3:r
4:▶DMS
5:R▶Pr(
6:R▶Pθ(
7:P▶Rx(
8:P▶Ry(
```

Note: Do not enter I TI-82. **54°32'** is inter 54° and 32', and " is

°(Degree)

°(degree) lets you de the current angle MO

angle°

'(Minute)

' (minute) lets you e minutes, and second be entered as numbe

degrees'minutes'sec

For example, enter 5 30 seconds.

```
54'32'30'*2
      109.0833
```

Note: The MODE sett interpret this entry a In **Radian** MODE, ent

r(Radians)

r (radian) lets you de the current angle MO

*angle*r

ANGLE Operations

To display the ANGLE menu, press 2nd [ANGLE]. The ANGLE menu displays angle indicators and instructions. When you select an item from the menu, the name is copied to the cursor location. Angle entries are interpreted according to the Radian/Degree MODE setting.

ANGLE menu

ANGLE	
1: °	Degree notation
2: '	Minute notation
3: r	Radian notation
4: ▶DMS	Display as degree/minute/second
5: R▶Pr(	Returns **R**, given **X** and **Y**
6: R▶Pθ(	Returns θ, given **X** and **Y**
7: P▶Rx(	Returns **X**, given **R** and θ
8: P▶Ry(	Returns **Y**, given **R** and θ

Note: Do not enter DMS numbers as **54°32'30"** on the TI-82. **54°32'** is interpreted as implied multiplication of 54° and 32', and " is a quote mark used to enter text.

°(Degree)

°(degree) lets you designate *angle* as degree, regardless of the current angle MODE setting. *angle* may be a list.

angle°

'(Minute)

' (minute) lets you enter numbers in DMS format. Degrees, minutes, and seconds may have decimal places, but must be entered as numbers, not as expressions.

degrees'*minutes*'*seconds*'

For example, enter **54'32'30'** for 54 degrees, 32 minutes, 30 seconds.

```
54'32'30'*2
      109.0833333
```

Note: The MODE setting must be **Degree** for the TI-82 to interpret this entry as degrees, minutes, and seconds. In **Radian** MODE, enter **54'32'30'°**.

r(Radians)

r (radian) lets you designate *angle* as radian, regardless of the current angle MODE setting. *angle* may be a list.

*angle*r

▶DMS

▶DMS (display as degree/minute/second) displays *answer* in degree, minute, second format. The MODE setting must be **Degree** for the TI-82 to interpret *answer* as degrees, minutes, and seconds. **▶DMS** is valid only at the end of a line.

answer▶**DMS**

```
54'32'30'*2
      109.0833333
Ans▶DMS
      109°5'0"
```

R▶Pr(
R▶Pθ(
P▶Rx(
P▶Ry(

R▶Pr(converts rectangular to polar and returns **R**, and **R▶Pθ(** converts rectangular to polar and returns θ, given *X* and *Y* rectangular coordinate values.

R▶Pr(*X*,*Y*)
R▶Pθ(*X*,*Y*)

```
R▶Pr(-1,0)
                    1
R▶Pθ(-1,0)
      3.141592654
```

P▶Rx(converts polar to rectangular and returns **X**, and **P▶Ry(** converts polar to rectangular and returns **Y**, given *R* and θ polar coordinate values.

P▶Rx(*R*,θ)
P▶Ry(*R*,θ)

```
P▶Rx(1,π)
                   -1
P▶Ry(1,π)
                    0
```


To display the TEST
you select from the
cursor location. The
return a list calculate

```
TEST  LOGIC
1:=
2:≠
3:>
4:≥
5:<
6:≤
```

Relational operators
return **1** if the test is
and *valueB* can be nu
(Chapter 10), but they
Relational operators
program flow and in
function over specific

valueA=*valueB*

```
{1,2,3}={3,2,1
        {0 1
{1,2,3}≠{3,2,1
        {1 0
{1,2,3}<{3,2,1
        {1 0
```

Tests

Relational operators
functions according t

- The expression 2+
addition first beca
compares 4 to 5.
- The expression 2+
performs the relati
parentheses, and t

TEST TEST (Relational) Operations

To display the TEST TEST menu, press 2nd [TEST]. When you select from the menu, the name is copied to the cursor location. These functions are valid for lists; they return a list calculated on an element-by-element basis.

TEST TEST Menu

TEST LOGIC	True if:
1:=	Equal
2:≠	Not equal to
3:>	Greater than
4:≥	Greater than or equal to
5:<	Less than
6:≤	Less than or equal to

=
≠
>
≥
<
≤

Relational operators compare *valueA* and *valueB* and return **1** if the test is true or **0** if the test is false. *valueA* and *valueB* can be numbers, expressions, lists, or matrices (Chapter 10), but they must match in type and dimension. Relational operators are often used in programs to control program flow and in graphing to control the graph of a function over specific values.

valueA=*valueB*

```
{1,2,3}={3,2,1}
                {0 1 0}
{1,2,3}≠{3,2,1}
                {1 0 1}
{1,2,3}<{3,2,1}
                {1 0 0}
```

Using Tests

Relational operators are evaluated after mathematical functions according to EOS rules (Chapter 1).

- The expression **2+2=2+3** returns **0**. The TI-82 does the addition first because of EOS rules, and then it compares 4 to 5.
- The expression **2+(2=2)+3** returns **6**. The TI-82 first performs the relational test because it is in parentheses, and then it adds 2, 1, and 3.

TEST LOGIC (Boolean) Operations

To display the TEST LOGIC menu, press 2nd [TEST] ▶. When you select from the menu, the name is copied to the cursor location. They are valid for lists; they return a list calculated on an element-by-element basis.

TEST LOGIC Menu

TEST LOGIC	True if:
1:and	Both values are nonzero (true)
2:or	At least one value is zero (false)
3:xor	Only one value is zero (false)
4:not	The value is zero (true)

Boolean Operators

Boolean operators are often used in programs to control program flow and in graphing to control the graph of a function over specific values. Values are interpreted as zero (false) or nonzero (true).

and or xor

and, **or**, and **xor** (exclusive or) return a value of **1** if a expression is true or **0** if the expression is false, according to the table below. *valueA* and *valueB* can be expressions.

valueA **and** *valueB*
valueA **or** *valueB*
valueA **xor** *valueB*

valueA	*valueB*		and	or	xor
≠0	≠0	returns	1	1	0
≠0	0	returns	0	1	1
0	≠0	returns	0	1	1
0	0	returns	0	0	0

not

not returns 1 if *value* (which can be an expression) is 0.

not *value*

Using Boolean Operations

Boolean logic is often used with relational tests. In a program, the following instructions store **4** into **C**:

```
PROGRAM:BOOLEAN
:2→A:3→B
:If A=2 and B=3
:Then:4→C
:Else:5→C
```

ns

C menu, press 2nd [TEST] ▸.
menu, the name is copied to
re valid for lists; they return a
nt-by-element basis.

:
lues are nonzero (true)
one value is zero (false)
e value is zero (false)
ue is zero (true)

used in programs to control
g to control the graph of a
s. Values are interpreted as
).

or) return a value of **1** if a
expression is false, according
nd *valueB* can be expressions.

	and	or	xor
s	1	1	0
s	0	1	1
s	0	1	1
s	0	0	0

can be an expression) is 0.

ith relational tests. In a
ctions store **4** into **C**:

Chapter 3: Function Graphing

This chapter describes function graphing on the TI-82 in detail. It also lays the foundation for using the other graphing features of the TI-82.

Chapter Contents

Getting Started: Graphing a Circle 3-2
Defining a Graph 3-3
Setting Graph Modes 3-4
Defining Functions in the Y= List 3-5
Selecting Functions 3-7
Defining the Viewing WINDOW 3-8
Setting WINDOW FORMAT 3-10
Displaying a Graph 3-11
Exploring a Graph with the Free-Moving Cursor ... 3-13
Exploring a Graph with TRACE 3-14
Exploring a Graph with ZOOM 3-16
Using ZOOM MEMORY 3-19
Setting ZOOM FACTORS 3-20
Using CALC (Calculate) Operations 3-21

Getting Started: Graphing a Circle

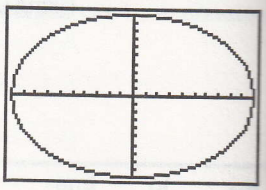
Getting Started is a fast-paced introduction. Read the chapter for details.

Graph a circle of radius 10, centered on the origin in the standard viewing window. To graph a circle, you must enter separate formulas for the upper and lower portions of the circle. Then use ZOOM Square to adjust the display to make the functions appear as a circle.

1. In **Func** MODE, press [Y=] to display the Y= edit screen. Press [2nd] [√] [(] **100** [−] [X,T,Θ] [x^2] [)] [ENTER] to enter the expression to define the top half of the circle, **$Y_1=\sqrt{(100-X^2)}$**.

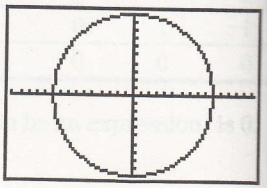
   The bottom half of the circle is defined by **$Y_2=-\sqrt{(100-X^2)}$**. However, on the TI-82 you can define one function in terms of another, so to define **$Y_2=-Y_1$**, press [(-)] [2nd] [Y-VARS] (to display the Y= variables menu) **1** (to select **Function...**) **1** (to select **Y_1**).

2. Press [ZOOM] and then select **ZStandard**. This is a quick way to reset the WINDOW variables to the standard values. It also graphs the functions; you do not need to press [GRAPH].

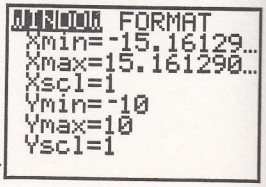
   

   Notice that the functions appear as an ellipse in the standard viewing window.

3. To adjust the display so each "dot" represents an equal width and height, press [ZOOM] and then select **ZSquare**. The functions are replotted and now appear as a circle on the display.

4. To see the effect of **ZSquare** on the WINDOW variables, press [WINDOW] and notice the new values for **Xmin**, **Xmax**, **Ymin**, and **Ymax**.

Defining a Graph

To define a graph, y
the functions to gra
and WINDOW FORM
you can plot, displa

Steps in Defining a Graph

There are six basic st
need to do all the ste
procedures are descr

1. Set the MODE to F
2. Enter or edit a fun
3. Select the Y= func
4. Define the viewing
5. Set the WINDOW F
6. Deselect stat plots

Exploring a Graph

Once you have define
use several tools of th
the function or functio
in this chapter.

Saving a Graph

You can store the elem
one of six graph databa
recall that database to

You can store a picture
of six graph pictures (G
superimpose that pictu

Defining a Graph

To define a graph, you set the modes, enter and select the functions to graph, and define the viewing WINDOW and WINDOW FORMAT. Once you have defined a graph, you can plot, display, and explore it.

Steps in Defining a Graph

There are six basic steps to defining a graph. You may not need to do all the steps each time you define a graph. The procedures are described in detail on the following pages.

1. Set the MODE to **Func** graphing.
2. Enter or edit a function in the Y= list.
3. Select the Y= function you want to graph.
4. Define the viewing WINDOW variables.
5. Set the WINDOW FORMAT.
6. Deselect stat plots, if appropriate (Chapter 12.)

Exploring a Graph

Once you have defined a graph, you can display it and then use several tools of the TI-82 to explore the behavior of the function or functions. These tools are described later in this chapter.

Saving a Graph

You can store the elements that define the current graph in one of six graph databases (Chapter 8). Later, you can recall that database to recreate the current graph.

You can store a picture of the current graph display in one of six graph pictures (Chapter 8). Later, you can superimpose that picture on the current graph.

Setting Graph Modes

Pressing [MODE] displays the current MODE settings (Chapter 1). The graphing MODE in function graphing must be Func.

Checking and Changing Graphing Modes

Press [MODE] to display the MODE settings. The current settings are highlighted.

The TI-82 has four graphing modes.

- **Func** (function graphing)
- **Par** (parametric graphing)
- **Pol** (polar graphing)
- **Seq** (sequence graphing)

To graph functions, you must select **Func** (function graphing). The basics of graphing on the TI-82 are described in this chapter. Differences in parametric graphing (Chapter 4), polar graphing (Chapter 5), and sequence graphing (Chapter 6) are described in those chapters.

Radian or **Degree** MODE may affect how some functions are interpreted. **Connected** or **Dot** affects how the selected functions are plotted. **Sequential** or **Simul** affects how functions are plotted if you have more than one function selected.

Setting Modes from a Program

You may set the graphing mode and other modes from a program.

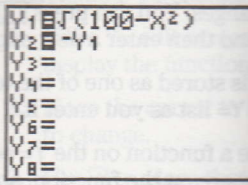
Begin on a blank line in the program editor. Press [MODE] to display the interactive MODE selection screen. Use [▼], [▲], [▶], and [◀] to place the cursor on the MODE that you want to select, and press [ENTER]. The name of the MODE is copied to the cursor location.

Defining Functions in the Y=

Pressing [Y=] accesses
enter the functions to
functions in memory a
more of these function

Displaying the Functions in the Y= List

Press [Y=] to display the
below, the Y1 and Y2 fu



Defining a New Function

To define a new functio
edit screen.

1. Move the cursor to
to define. If necessa
previously entered f
2. Enter the expressio
   - You may use fun
matrices and list
expression evalu
number, that poi
occur.
   - The independent
may press [X,T,θ]
the **X** variable. (
independent vari
   - The expression i
defined function
3. When you complete
move to the beginni

Defining Functions in the Y= List

Pressing [Y=] accesses the Y= edit screen, where you enter the functions to graph. You can store up to ten functions in memory at one time. You can graph one or more of these functions at a time.

Displaying the Functions in the Y= List

Press [Y=] to display the Y= edit screen. In the example below, the **Y1** and **Y2** functions are defined.

Defining a New Function

To define a new function, enter an expression on the Y= edit screen.

1. Move the cursor to the function in the Y= list you want to define. If necessary, press [CLEAR] to erase a previously entered function.
2. Enter the expression to define the function.
   - You may use functions and variables (including matrices and lists) in the expression. If the expression evaluates to a value that is not a real number, that point is not plotted; an error does not occur.
   - The independent variable in the function is **X**. You may press [X,T,Θ], rather than pressing [ALPHA] [X], for the **X** variable. (**Func** MODE defines the independent variable as **X**.)
   - The expression is stored as one of the ten user-defined functions in the Y= list as you enter it.
3. When you complete the expression, press [ENTER] to move to the beginning of the next function.

Editing a Function

1. Move the cursor to the function in the Y= list you want to change.
2. Make the changes. You can press [CLEAR] to erase the expression and then enter a new expression.

The expression is stored as one of the ten user-defined functions in the Y= list as you enter it.

Clearing a Function

To clear or erase a function on the Y= edit screen, position the cursor anywhere on the function, and then press [CLEAR].

Defining Functions from the Home Screen or a Program

1. Begin on a blank line. Press [ALPHA] ["], enter the expression, and then press [ALPHA] ["] again.
2. Press [STO▸].
3. Press [2nd] [Y-VARS], select **Function...**, and then select the name of the function, which is copied to the cursor location.
4. Press [ENTER] to complete the instruction.

"*expression*"→**Y***n*

When the instruction is executed, the TI-82 stores the expression to the Y= list, selects the function, and displays the message Done.

Evaluating Y= Functions in Expressions

You can the calculate the value of a Y= function at a specified value of **X**. For example, if **Y1=.2X3–2X+6**:

```
Y1(0)
                    6
Y1({0,1,2,3,4})
{6 4.2 3.6 5.4 ...
```


Selecting Functions

Only functions that a
functions may be se

Turning a Function "On" or "Off"

You select and desele
on the Y= edit screen.
highlighted. To chang

1. If the Y= edit scre
display the functio
2. Move the cursor to
to change.
3. Use ◂ to place the
function.
4. Press [ENTER] to cha

Note: When you enter
automatically. When y

Leaving the Y= Edit Screen

To leave the Y= edit sc

- Select another scre
such as [GRAPH] or
- Press [2nd] [QUIT] to

Selecting Functions from the Home Screen or a Program

1. Begin on a blank li
On/Off... . The ON/
2. Select the instructio
copied to the curso
3. If you want to turn
the number of the f

When the instruction is
function in the current
Done is displayed.

FnOn
FnOff
FnOn *function1,functi*
FnOff *function1,functi*

For example, in **Func M**
functions in the Y= list

tion in the Y= list you want

press [CLEAR] to erase the new expression.

of the ten user-defined nter it.

he Y= edit screen, position ction, and then press

[ALPHA] ["], enter the [ALPHA] ["] again.

nction..., and then select ich is copied to the cursor

instruction.

l, the TI-82 stores the the function, and displays

f a Y= function at a e, if **Y1=.2X3–2X+6**:

Selecting Functions

Only functions that are selected are graphed. Up to ten functions may be selected at one time.

Turning a Function "On" or "Off"

You select and deselect ("turn on" and "turn off") functions on the Y= edit screen. The = sign on a selected function is highlighted. To change the selection status of a function:

1. If the Y= edit screen is not displayed, press [Y=] to display the functions.
2. Move the cursor to the function whose status you want to change.
3. Use [◄] to place the cursor over the = sign of the function.
4. Press [ENTER] to change the status.

Note: When you enter or edit a function, it is selected automatically. When you clear a function, it is deselected.

Leaving the Y= Edit Screen

To leave the Y= edit screen:

- Select another screen by pressing the appropriate key, such as [GRAPH] or [WINDOW].
- Press [2nd] [QUIT] to return to the Home screen.

Selecting Functions from the Home Screen or a Program

1. Begin on a blank line. Press [2nd] [Y-VARS] and select **On/Off...** . The ON/OFF menu is displayed.
2. Select the instruction you want, **FnOn** or **FnOff**. It is copied to the cursor location.
3. If you want to turn specific functions on or off, enter the number of the function(s), separated by commas.

When the instruction is executed, the status of each function in the current graph mode is set appropriately and Done is displayed.

FnOn
FnOff
FnOn *function1*,*function2*, . . .
FnOff *function1*,*function2*, . . .

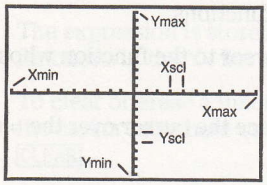
For example, in **Func** MODE, **FnOff:FnOn 1,3** turns off all functions in the Y= list and then turns on **Y1** and **Y3**.

Defining the Viewing WINDOW

The WINDOW variables determine the boundaries and other attributes of the viewing WINDOW. The WINDOW variables are shared by all graphing modes.

TI-82 Viewing WINDOW

The viewing WINDOW of the TI-82 is the portion of the coordinate plane defined by **Xmin**, **Xmax**, **Ymin**, and **Ymax**. The distance between tick marks is defined by **Xscl** for the **X** axis and **Yscl** for the **Y** axis.



Checking the Viewing WINDOW

Press [WINDOW] to display the current WINDOW variable values. The values shown here are the standard values.

```
WINDOW FORMAT
Xmin=-10
Xmax=10
Xscl=1
Ymin=-10
Ymax=10
Yscl=1
```

Changing a WINDOW Variable Value

1. Press [▼] to move to the WINDOW variable you want to change.
2. To enter a real value (which can be an expression), you may do any of the following:
   - Position the cursor and then make the changes.
   - Press [CLEAR] to clear the value and then enter a new value.
   - Begin entering a new value. The original value is cleared automatically when you begin typing.
3. Press [ENTER], [▼], or [▲]. If you entered an expression, it is evaluated. The new value is stored.

Xmin must be less than **Xmax** and **Ymin** must be less than **Ymax**, or you will get an error message when you press [GRAPH]. To turn off the tick marks, set **Xscl=0** or **Yscl=0**.

Leaving the WINDOW Edit Screen

To leave the WINDOW edit screen:

- Select another screen by pressing the appropriate key, such as [GRAPH] or [Y=].
- Press [2nd] [QUIT] to return to the Home screen.

Storing to a WINDOW Variable from the Home Screen or a Program

Begin on a blank line.

1. Enter the value you want to store (which can be an expression).
2. Press [STO▸].
3. Press [VARS] to display the VARS menu.
4. Select **Window...** to display the WINDOW variables.
5. Select the WINDOW variable to which you want to store. The name of the variable is copied to the cursor location where you are editing.
6. Press [ENTER] to complete the instruction.

When the instruction is executed, the TI-82 stores the value in the WINDOW variable.

Note: You can use a WINDOW variable in an expression by performing steps 3, 4, and 5.

ΔX and ΔY

The variables **ΔX** and **ΔY** define the distance between the centers of two adjoining pixels on a graph (graphing accuracy).

$$\Delta X = \frac{(\text{Xmax} - \text{Xmin})}{94} \qquad \Delta Y = \frac{(\text{Ymax} - \text{Ymin})}{62}$$

ΔX and **ΔY** are not on the WINDOW screen; they are accessible through the VARS Window menu. **ΔX** and **ΔY** are calculated from **Xmin**, **Xmax**, **Ymin**, and **Ymax** when a graph is displayed.

You can store values directly to **ΔX** and **ΔY**, in which case **Xmax** and **Ymax** are calculated from **ΔX**, **Xmin**, **ΔY**, and **Ymin** immediately.

Setting WINDOW FORMAT

WINDOW FORMAT determines how a graph appears on the display. WINDOW FORMAT settings apply to all graphing modes.

Checking WINDOW FORMAT

To display the WINDOW FORMAT screen, press [WINDOW] [▶]. The current settings are highlighted.

```
WINDOW FORMAT
RectGC PolarGC      Sets rectangular or polar cursor
CoordOn CoordOff    Sets cursor coordinates on or off
GridOff GridOn      Sets grid off or on
AxesOn AxesOff      Sets axes on or off
LabelOff LabelOn    Sets axes label off or on
```

Changing WINDOW FORMAT

1. Move the cursor to the row of the setting you want to change. The setting the cursor is on blinks.
2. Move the cursor to the setting you want and press [ENTER].

RectGC PolarGC

The cursor coordinate setting determines if the cursor location is displayed (if **CoordOn**) as rectangular coordinates **X** and **Y** or polar coordinates **R** and θ. It also determines which variables are updated. In **RectGC** (rectangular graphing coordinates) FORMAT, plotting the graph, moving the free-moving cursor, or tracing updates and displays **X** and **Y**. In **PolarGC** (polar graphing coordinates) FORMAT, **X**, **Y**, **R**, and θ are updated, and **R** and θ are displayed.

CoordOn CoordOff

CoordOn (coordinates on) displays the function number in the upper-right corner and the cursor coordinates at the bottom of the graph. **CoordOff** (coordinate off) does not display the function number or the coordinates for the free-moving cursor or during TRACE.

GridOff GridOn

Grid points correspond to the axis tick marks. **GridOff** does not display grid points. **GridOn** does display the grid points.

AxesOn AxesOff

AxesOn displays the axes. **AxesOff** does not display the axes. It overrides the Axis Label setting.

LabelOff LabelOn

LabelOn and **LabelOff** determine whether to display a label for the axes (**X** and **Y** or **R** and θ).

Displaying a Graph

Pressing [GRAPH] grap edit screen. The curr current values of the viewing WINDOW.

Displaying a New Graph

Press [GRAPH] to displa or functions. (Some o ZOOM CALC operatio As a graph is plotted, are updated.

Pausing a Graph

Note: While a graph i

- Press [ENTER] to pau resume plotting.
- Press [ON] to stop g over.

Smart Graph

When you press [GRAPH screen immediately if the functions to be re was displayed.

If you have not change graph was last display immediately. If you ha pressing [GRAPH] replot

- Changed a MODE s
- Changed a functio
- Selected or desele
- Changed the value
- Changed a WINDO
- Cleared drawings
- Changed a STAT P

Displaying a Graph

Pressing [GRAPH] graphs any functions selected on the Y= edit screen. The current MODE settings apply, and the current values of the WINDOW variables define the viewing WINDOW.

Displaying a New Graph

Press [GRAPH] to display the graph of the selected function or functions. (Some operations, such as TRACE and the ZOOM CALC operations, display the graph automatically.) As a graph is plotted, the busy indicator is on and **X** and **Y** are updated.

Pausing a Graph

Note: While a graph is being plotted, you can:

- Press [ENTER] to pause graphing, then press [ENTER] to resume plotting.
- Press [ON] to stop graphing, then press [GRAPH] to start over.

Smart Graph

When you press [GRAPH], Smart Graph displays the graph screen immediately if nothing has changed that requires the functions to be replotted since the last time the graph was displayed.

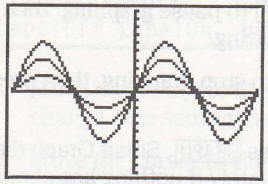
If you have not changed any of the following since the graph was last displayed, Smart Graph displays the graph immediately. If you have changed one or more of these, pressing [GRAPH] replots the graph based on the new values.

- Changed a MODE setting that affects graphs.
- Changed a function.
- Selected or deselected a function.
- Changed the value of a variable in a selected function.
- Changed a WINDOW variable or a FORMAT setting.
- Cleared drawings by selecting **ClrDraw** (Chapter 8).
- Changed a STAT PLOT definition (Chapter 12).

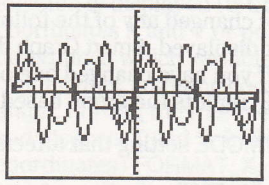
Graphing a Family of Curves

If you enter a list (Chapter 11) as an element in an expression, the TI-82 plots the function for each value in the list, graphing a family of curves. (In **Simul**, it graphs all functions for the first element, and so on.)

{2,4,6}sin X graphs three functions: **2 sin X**, **4 sin X**, and **6 sin X**.



{2,4,6}sin {1,2,3}X graphs **2 sin X**, **4 sin 2X**, and **6 sin 3X**.



**While a graph is dis
moving cursor anyw
coordinates of any**

Free-Moving Cursor

You can use ◄, ►, ▲
graph. When you firs
visible. As soon as y
moves from the cent

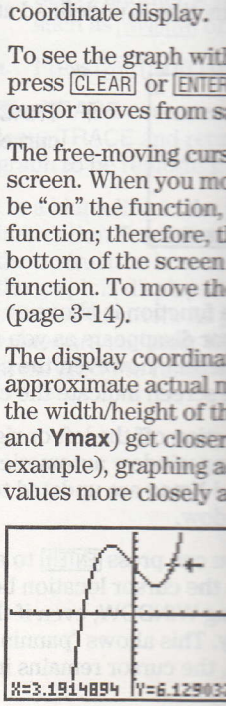
As you move the cur
values of the cursor
the screen (if **Coord**
appear in normal flo
display settings on th
coordinate display.

To see the graph with
press CLEAR or ENTER
cursor moves from s

Graphing Accuracy

The free-moving curs
screen. When you mo
be "on" the function,
function; therefore, t
bottom of the screen
function. To move th
(page 3-14).

The display coordina
approximate actual n
the width/height of th
and **Ymax**) get closer
example), graphing a
values more closely a



11) as an element in an
the function for each value in
f curves. (In **Simul**, it graphs all
ent, and so on.)

nctions: **2 sin X**, **4 sin X**, and

sin X, **4 sin 2X**, and **6 sin 3X**.

Exploring a Graph with the Free-Moving Cursor

While a graph is displayed, you can move the free-moving cursor anywhere on the graph and display the coordinates of any location on the graph.

Free-Moving Cursor

You can use ◄, ►, ▲, or ▼ to move the cursor around the graph. When you first display the graph, no cursor is visible. As soon as you press ◄, ►, ▲, or ▼, the cursor moves from the center of the viewing window.

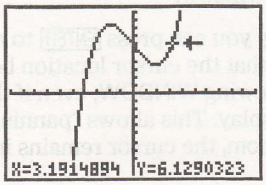
As you move the cursor around the graph, the coordinate values of the cursor location are displayed at the bottom of the screen (if **CoordOn**). Coordinate values generally appear in normal floating-decimal format. The numeric display settings on the MODE screen do not affect coordinate display.

To see the graph without the cursor or coordinate values, press CLEAR or ENTER. When you press ◄, ►, ▲, or ▼, the cursor moves from same position.

Graphing Accuracy

The free-moving cursor moves from dot to dot on the screen. When you move the cursor to a dot that appears to be "on" the function, it may be near, but not on, the function; therefore, the coordinate value displayed at the bottom of the screen is not necessarily a point on the function. To move the cursor along a function, use TRACE (page 3-14).

The display coordinate values of the free-moving cursor approximate actual math coordinates accurate to within the width/height of the dot. As **Xmin** and **Xmax** (and **Ymin** and **Ymax**) get closer together (after a **Zoom In**, for example), graphing accuracy increases, and the coordinate values more closely approximate the math coordinates.



Free-moving cursor "on" the curve

Exploring a Graph with TRACE

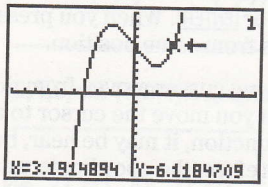
TRACE moves the cursor from one plotted point to the next along a function, while displaying the cursor coordinates at the bottom of the screen.

Beginning a Trace

Press [TRACE] to begin a trace. If the graph is not displayed already, the TI-82 displays it. The cursor is on the first selected function in the Y= list at the middle **X** value on the screen. The number of the function shows at the upper right of the display.

Moving along a Function

[▶] and [◀] move the cursor along the function. Each press moves the cursor from one plotted point to the next. [2nd] [▶] and [2nd] [◀] move the cursor five plotted points at a time. The **Y** value is calculated from the **X** value; that is, **Y=Y*n*(X)**. If the function is undefined at an **X** value, the **Y** value is blank.



TRACE cursor on the curve.

If the **Y** value of a function is above or below the viewing window, the cursor disappears as you move it to that portion of the function; however, the coordinate values at the bottom of the screen indicate the cursor coordinates.

Panning to the Left or Right

If you trace a function off the left or right edge of the screen, the viewing window automatically pans to the left or right. **Xmin** and **Xmax** are updated to correspond to the new viewing window.

QuickZoom

While tracing, you can press [ENTER] to adjust the viewing WINDOW so that the cursor location becomes the center of the new viewing WINDOW, even if the cursor is above or below the display. This allows "panning" up and down. After QuickZoom, the cursor remains in TRACE.

om one plotted point to the
displaying the cursor
f the screen.

If the graph is not displayed
The cursor is on the first
t at the middle **X** value on the
nction shows at the upper

ng the function. Each press
otted point to the next.
rsor five plotted points at a
l from the **X** value; that is,
lefined at an **X** value, the **Y**

TRACE cursor on the
curve.

bove or below the viewing
as you move it to that
er, the coordinate values at
ate the cursor coordinates.

eft or right edge of the
tomatically pans to the left
dated to correspond to the

TER] to adjust the viewing
ation becomes the center
ven if the cursor is above or
"panning" up and down.
nains in TRACE.

Moving from Function to Function

To trace another selected function on the graph, use [▼] or [▲] to move the cursor to that function. The cursor movement is based on the order of the selected functions in the Y= list, not the appearance of the functions as graphed on the screen. The cursor moves to the new function at the same **X** value. The function number in the upper right corner of the display changes.

Leaving TRACE

To leave TRACE:

- Select another screen by pressing the appropriate key, such as [WINDOW] or [ZOOM].
- Press [2nd] [QUIT] to return to the Home screen.

The TRACE cursor remains in the same location if you leave TRACE and return, if Smart Graph has not caused the graph to be replotted.

Using TRACE in a Program

On a blank line in the program editor, press [TRACE]. The instruction **Trace** is copied to the cursor location. When the instruction is encountered during program execution, the graph is displayed with the TRACE cursor on the first selected function. As you trace, the cursor coordinate values are updated. When you are done tracing functions, press [ENTER] to resume program execution.

Exploring a Graph with ZOOM

Pressing [ZOOM] accesses a menu that allows you to adjust the viewing WINDOW of the graph quickly in a variety of ways. All of the ZOOM commands are accessible from programs.

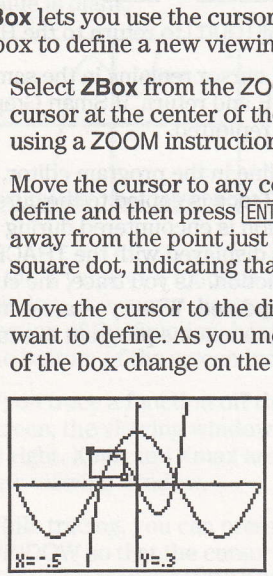
ZOOM Menu

ZOOM MEMORY	
1: ZBox	Draws box to define viewing WINDOW
2: Zoom In	Magnifies graph around cursor
3: Zoom Out	Views more of graph around cursor
4: ZDecimal	Sets .1 as dot size
5: ZSquare	Sets equal sized dots on **X** and **Y** axes
6: ZStandard	Sets standard WINDOW variables
7: ZTrig	Sets built-in trig WINDOW variables
8: ZInteger	Sets integer values on **X** and **Y** axes
9: ZoomStat	Sets values for current lists

ZBox

ZBox lets you use the cursor to select opposite corners of a box to define a new viewing WINDOW.

1. Select **ZBox** from the ZOOM menu. The different cursor at the center of the screen indicates that you are using a ZOOM instruction.
2. Move the cursor to any corner of the box you want to define and then press [ENTER]. As you move the cursor away from the point just selected, you see a small square dot, indicating that the first corner is selected.
3. Move the cursor to the diagonal corner of the box you want to define. As you move the cursor, the boundaries of the box change on the screen.



Note: You can cancel **ZBox** any time before you press [ENTER] by pressing [CLEAR].

4. When the box is defined as you want it, press [ENTER] to replot the graph.

You can repeat steps 2 through 4 to do another **ZBox**. To cancel **ZBox**, press [CLEAR].

Zoom In
Zoom Out

Zoom In magnifies the
Zoom Out displays a g
on the cursor location.
XFact and **YFact** settin
zoom.

1. After checking or c
(page 3-20), select

Notice the differen
using a ZOOM instr

2. Move the cursor to
center of the new v

The TI-82 adjusts th
YFact, updates the
selected functions,

3. To zoom in on the g
   - To zoom in at th
   - To zoom in at a
point that you w
viewing WINDO

Zoom Out

The procedure for **Zoo**

Leaving Zoom In or Zoom Out

To leave **Zoom In** or **Zo**

- Select another scre
such as [TRACE] or [GR
- Press [2nd] [QUIT] to

s a menu that allows you to
OW of the graph quickly in a
e ZOOM commands are
ns.

ox to define viewing WINDOW
s graph around cursor
ore of graph around cursor
dot size
l sized dots on **X** and **Y** axes
dard WINDOW variables
-in trig WINDOW variables
ger values on **X** and **Y** axes
es for current lists

sor to select opposite corners of
ing WINDOW.

ZOOM menu. The different
the screen indicates that you are
ion.

corner of the box you want to
ENTER]. As you move the cursor
st selected, you see a small
hat the first corner is selected.

diagonal corner of the box you
move the cursor, the boundaries
e screen.

Box any time before you press
].

l as you want it, press [ENTER] to

ugh 4 to do another **ZBox**. To

Zoom In
Zoom Out

Zoom In magnifies the graph around the cursor location. **Zoom Out** displays a greater portion of the graph, centered on the cursor location, to provide a more global view. The **XFact** and **YFact** settings determine the extent of the zoom.

1. After checking or changing **XFact** and **YFact** (page 3-20), select **Zoom In** from the ZOOM menu.

   Notice the different cursor. It indicates that you are using a ZOOM instruction.

2. Move the cursor to the point that you want as the center of the new viewing WINDOW, then press [ENTER].

   The TI-82 adjusts the viewing WINDOW by **XFact** and **YFact**, updates the WINDOW variables, and replots the selected functions, centered on the cursor location.

3. To zoom in on the graph again:

   - To zoom in at the same point, press [ENTER].
   - To zoom in at a new point, move the cursor to the point that you want as the center of the new viewing WINDOW and then press [ENTER].

Zoom Out

The procedure for **Zoom Out** is the same as for **Zoom In**.

Leaving Zoom In or Zoom Out

To leave **Zoom In** or **Zoom Out**:

- Select another screen by pressing the appropriate key, such as [TRACE] or [GRAPH].
- Press [2nd] [QUIT] to return to the Home screen.

ZDecimal — **ZDecimal** replots the functions immediately, updating the WINDOW variables to preset values that set ΔX and ΔY equal to **.1** and defining the **X** and **Y** value of each pixel as one decimal.

Xmin = -4.7	**Ymin = -3.1**
Xmax = 4.7	**Ymax = 3.1**
Xscl = 1	**Yscl = 1**

ZSquare — **ZSquare** replots the functions immediately, redefining the WINDOW based on the current WINDOW variables, but adjusted in only one direction so that **ΔX=ΔY**. This makes the graph of a circle look like a circle. **Xscl** and **Yscl** remain unchanged. The midpoint of the current graph (not the intersection of the axes) becomes the midpoint of the new graph.

ZStandard — **ZStandard** replots the functions immediately, updating the WINDOW variables to the standard values:

Xmin = -10	**Ymin = -10**
Xmax = 10	**Ymax = 10**
Xscl = 1	**Yscl = 1**

ZTrig — **ZTrig** replots the functions immediately, updating the WINDOW variables to preset values appropriate for trig plotting functions. In **Radian** MODE these are:

Xmin = -(47/24)π	**Ymin = -3**
Xmax = (47/24)π	**Ymax = 3**
Xscl = π/2	**Yscl = 1**

ZInteger — **ZInteger** redefines the viewing WINDOW so **ΔX=1** and **ΔY=1**, **Xscl=10**, and **Yscl = 10**, replotting the functions after you move the cursor to the point that you want as the center of the new WINDOW and press [ENTER].

ZoomStat — **ZoomStat** redefines the viewing WINDOW so that all statistical data points are displayed. For one-variable plots (histograms and box plots), only **Xmin** and **Xmax** are adjusted. If the top of the histogram is not shown, use TRACE to determine the value for **Ymax**.

ZPrevious allows
prior to the previ
of the current WI
MEMORY variable
the values stored

```
ZOOM  MEMORY
1:ZPrevious
2:ZoomSto
3:ZoomRcl
4:SetFactors…
```

ZPrevious — When you select ZP menu, the graph is of the graph displa did.

ZoomSto — To store the curren from the ZOOM ME necessary, and the variables are stored **ZXmin**, **ZXmax**, **ZX** action is immediate

These variables are modes. For exampl MODE also changes

The user-defined W values until you sto

ZoomRcl — To view the selecte WINDOW, select **Zo** menu. The WINDOW defined values, and

Using ZOOM MEMORY from the Home Screen or a Program — From the Home scr directly to any of the

From a program, yo instructions from th

ontinued)

ons immediately, updating the
t values that set ΔX and ΔY
X and Y value of each pixel as

-3.1
= 3.1
1

ns immediately, redefining the
ent WINDOW variables, but
n so that ΔX=ΔY. This makes
e a circle. **Xscl** and **Yscl**
point of the current graph (not
becomes the midpoint of the

ons immediately, updating the
andard values:

-10
10

nmediately, updating the
values appropriate for trig
MODE these are:

-3
3

g WINDOW so ΔX=1 and
, replotting the functions
the point that you want as the
nd press ENTER.

ng WINDOW so that all
layed. For one-variable plots
nly **Xmin** and **Xmax** are
ogram is not shown, use
e for **Ymax**.

Using ZOOM MEMORY

ZPrevious allows you to return to the WINDOW displayed prior to the previous ZOOM. ZoomSto stores the values of the current WINDOW variables to user-defined ZOOM MEMORY variables. ZoomRcl changes the WINDOW to the values stored with ZoomSto.

ZOOM MEMORY menu

ZOOM MEMORY	
1: ZPrevious	Uses previous viewing WINDOW
2: ZoomSto	Stores user-defined WINDOW
3: ZoomRcl	Recalls user-defined WINDOW
4: SetFactors...	Changes **Zoom In**, **Zoom Out** factors

ZPrevious

When you select **ZPrevious** from the ZOOM MEMORY menu, the graph is replotted using the WINDOW variables of the graph displayed prior to the previous ZOOM that you did.

ZoomSto

To store the current viewing WINDOW, select **ZoomSto** from the ZOOM MEMORY menu. The graph is displayed if necessary, and the values of the current WINDOW variables are stored in the user-defined ZOOM variables: **ZXmin**, **ZXmax**, **ZXscl**, **ZYmin**, **ZYmax**, and **ZYscl**. The action is immediate, there is no prompting on the display.

These variables are global; they apply to all graphing modes. For example, changing the value of **ZXmin** in **Func** MODE also changes it in **Par** MODE.

The user-defined WINDOW variables contain the standard values until you store to them the first time.

ZoomRcl

To view the selected graphing functions in the user-defined WINDOW, select **ZoomRcl** from the ZOOM MEMORY menu. The WINDOW variables are updated with the user-defined values, and the graph is plotted.

Using ZOOM MEMORY from the Home Screen or a Program

From the Home screen or a program, you can store directly to any of the user-defined ZOOM variables.

From a program, you can select the **ZoomSto** or **ZoomRcl** instructions from the ZOOM MEMORY menu.

Setting ZOOM FACTORS

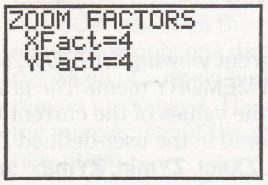
The ZOOM FACTORS, XFact and YFact, determine the extent of the change for the viewing window created by Zoom In or Zoom Out on a graph.

ZOOM FACTORS

ZOOM FACTORS are positive numbers (not necessarily integers) greater than or equal to 1. They define the magnification or reduction factor used to **Zoom In** or **Zoom Out** around a point.

Checking XFact and YFact

To review the current values of **XFact** and **YFact**, select **SetFactors...** from the ZOOM MEMORY menu. The ZOOM FACTORS screen appears (the values shown are the standard values).



Changing XFact and YFact

To change **XFact** or **YFact**:

- Enter a new value. The original value is cleared automatically when you begin typing.
- Position the cursor over the digit you want to change. Then type over it or use [DEL] to delete it.

Leaving ZOOM FACTORS

To leave ZOOM FACTORS:

- Select another screen by pressing the appropriate key, such as [WINDOW] or [ZOOM].
- Press [2nd] [QUIT] to return to the Home screen.

CALC (Calculate) Operati

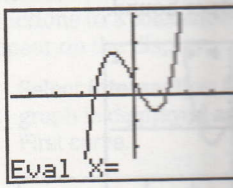
Pressing [2nd] [CALC] (abo with operations you can functions. You are promp interval, and point.

CALCULATE

CALCULATE	
1: value	Calcu
2: root	Finds
3: minimum	Finds
4: maximum	Finds
5: intersect	Finds
6: dy/dx	Finds
7: ∫f(x)dx	Finds

value evaluates currently value of **X**.

1. Select **value** from the displayed, with a prom



2. Enter a real value for (which can be an exp value entered for **X**, is no value, [CLEAR] ca
3. Press [ENTER]. The resu function in the list at values are displayed **CoordOff** on the WIN
4. Press [▼] or [▲] to mov the entered **X** value. moving cursor appea back to the **X** value.

Using CALC (Calculate) Operations

Pressing [2nd] [CALC] (above [TRACE]) accesses a menu with operations you can use to analyze the current graph functions. You are prompted to specify the function(s), interval, and point.

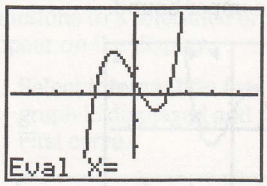
CALCULATE

CALCULATE	
1: value	Calculates function value for given **X**
2: root	Finds root of function
3: minimum	Finds minimum of function
4: maximum	Finds maximum of function
5: intersect	Finds intersection of functions
6: dy/dx	Finds numeric derivative of function
7: ∫f(x)dx	Finds numeric integral of function

value

value evaluates currently selected functions for a specified value of **X**.

1. Select **value** from the CALC menu. The current graph is displayed, with a prompt for you to enter **X**.

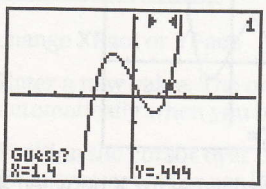


2. Enter a real value for **X** between **Xmin** and **Xmax** (which can be an expression). **Note:** When there is a value entered for **X**, [CLEAR] clears the value; when there is no value, [CLEAR] cancels **value**.
3. Press [ENTER]. The result cursor is on the first selected function in the list at the entered **X** and the coordinate values are displayed (even if you have selected **CoordOff** on the WINDOW FORMAT screen).
4. Press [▼] or [▲] to move the cursor between functions at the entered **X** value. When [◀] or [▶] are pressed, the free-moving cursor appears. It cannot necessarily move back to the **X** value.

root

root (CALC item 2) uses **solve(** (Chapter 2) to find the root (zero or **X**-intercept) of a function. Selecting good values for the bounds and a guess help it find the correct root and find it more quickly.

1. Select **root** from the CALC menu. The current graph is displayed, with a prompt to enter Lower Bound.
2. Use ▼ or ▲ to move the cursor to the function for which you want to find the root.
3. Move the cursor to the **X** value you want for the lower bound of the interval and press ENTER. A ▶ indicator at the top of the display shows the lower bound.
4. Set the upper bound in the same way. An indicator shows the upper bound.



5. You are prompted for a Guess to help the TI-82 find the correct root and to find it more quickly.
6. Use ◀ or ▶ to move the cursor to a point near the root of the function, between the bounds. Press ENTER.

The result cursor is on the solution and the coordinate values are displayed (even if you have selected **CoordOff** on the WINDOW FORMAT screen). When you press ◀, ▶, ▲, or ▼, the free-moving cursor appears.

minimum

minimum (CALC
the minimum or
interval to a tole

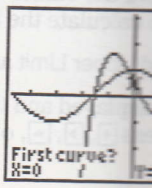
1. Select minim
The current
2. Set Lower Bo
for **root**.

The result curso
values are displa
on the WINDOW
▲, or ▼, the free

intersect

intersect (CALC
functions to a to
appear on the dis

1. Select interse
graph is displ
First curve.



2. Use ▼ or ▲ t
and press ENTE
3. Use ▼ or ▲ t
and press ENTE

The result cursor
values are displa
on the WINDOW F
▲, or ▼, the free-

ns (Continued)

ve((Chapter 2) to find the root
ction. Selecting good values
elp it find the correct root and

C menu. The current graph is
to enter Lower Bound.

cursor to the function for
e root.

value you want for the lower
press [ENTER]. A ▶ indicator at
ws the lower bound.

e same way. An indicator

uess to help the TI-82 find the
more quickly.

ursor to a point near the root
he bounds. Press [ENTER].

lution and the coordinate
ou have selected **CoordOff**
een). When you press [◀], [▶],
sor appears.

minimum
maximum

minimum (CALC item 3) and **maximum** (CALC item 4) find the minimum or maximum of a function in a specified interval to a tolerance of 1E-5.

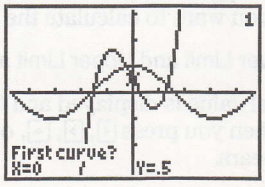
1. Select **minimum** or **maximum** from the CALC menu. The current graph is displayed.
2. Set Lower Bound, Upper Bound, and Guess as described for **root**.

The result cursor is on the solution and the coordinate values are displayed (even if you have selected **CoordOff** on the WINDOW FORMAT screen). When you press [◀], [▶], [▲], or [▼], the free-moving cursor appears.

intersect

intersect (CALC item 5) finds the intersection of two functions to a tolerance of 1E-5. The intersection must appear on the display.

1. Select **intersection** from the CALC menu. The current graph is displayed and you are prompted to select the First curve.



2. Use [▼] or [▲] to move the cursor to the first function and press [ENTER].
3. Use [▼] or [▲] to move the cursor to the second function and press [ENTER].

The result cursor is on the solution and the coordinate values are displayed (even if you have selected **CoordOff** on the WINDOW FORMAT screen). When you press [◀], [▶], [▲], or [▼], the free-moving cursor appears.

dy/dx

dy/dx (numerical derivative, CALC item 6) finds the numerical derivative (slope) of a function at a point with ε = 1E-3.

1. Select **dy/dx** from the CALC menu. The current graph is displayed.
2. Move the cursor to the **X** value at which you want to calculate the derivative and press [ENTER].

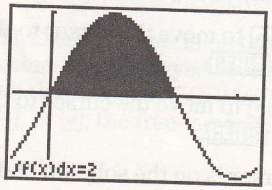
The result cursor is on the solution and the coordinate values are displayed (even if you have selected **CoordOff** on the WINDOW FORMAT screen). When you press [◄], [►], [▲], or [▼], the free-moving cursor appears.

∫f(x)dx

∫f(x)dx (numerical integral, CALC item 7) finds the numerical integral of a function in a specified interval. It uses the **fnInt(** function, with a tolerance of 1E-5.

1. Select **∫f(x)dx** from the CALC menu. The current graph is displayed, with a prompt to enter Lower Bound.
2. Use [▼] or [▲] to move the cursor to the function for which you want to calculate the integral.
3. Set Lower Limit and Upper Limit as described for **root**.

The integral value is displayed and the integrated area is shaded. When you press [◄], [►], [▲], or [▼], the free-moving cursor appears.



Note: The shaded area is a drawing. Use **ClrDraw** or any change that invokes Smart Graph to clear the shaded area. (Chapter 8).

This chapter descri
equations on the T
graphing, you shou
Function Graphing.

Chapter Contents
Getting Started: Path
Defining and Displa
Exploring a Paramet

ns (Continued)

CALC item 6) finds the
of a function at a point with

LC menu. The current graph is

alue at which you want to
d press [ENTER].

lution and the coordinate
ou have selected **CoordOff**
een). When you press [◄], [►],
sor appears.

ALC item 7) finds the
n in a specified interval. It
a tolerance of 1E-5.

LC menu. The current graph
to enter Lower Bound.

ursor to the function for
e the integral.

Limit as described for **root**.

and the integrated area is
[▲], or [▼], the free-moving

wing. Use **ClrDraw** or any
h to clear the shaded area.

Chapter 4: Parametric Graphing

This chapter describes how to graph parametric equations on the TI-82. Before doing parametric graphing, you should be familiar with Chapter 3, Function Graphing.

Chapter Contents

Getting Started: Path of a Ball	. . . . .	4-2
Defining and Displaying a Parametric Graph	. . . . .	4-3
Exploring a Parametric Graph	. . . . .	4-6

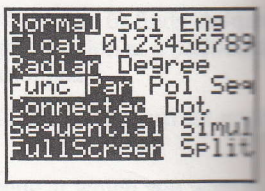
Getting Started: Path of a Ball

Getting Started is a fast-paced introduction. Read the chapter for details.

Graph the parametric equation that describes the position of a ball kicked at an angle of 60° with an initial velocity of 15 meters per second. (Ignore air resistance.) What is the maximum height? When does the ball strike the ground?

1. Press MODE. Press ▼ ▼ ▼ ▶ ENTER to select **Par** MODE.

   For initial velocity v_0 and angle θ, the horizontal component of the position of the ball as a function of time is $X(t)=tv_0\cos\theta$. The vertical component is $Y(t)=tv_0\sin\theta-(g/2)t^2$. The gravity constant g is 9.8 m/sec^2.

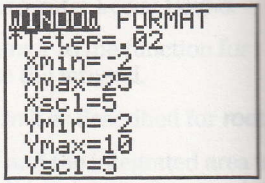


2. Press Y=. Press **15** X,T,Θ COS **60** 2nd [ANGLE] **1** (to select °) ENTER to define the **X** portion of the parametric equation *in terms of* **T**.

3. Press **15** X,T,Θ SIN **60** 2nd [ANGLE] **1** (to select °) (−) (**9.8** ÷ **2**) X,T,Θ x^2 ENTER to define the **Y** portion.

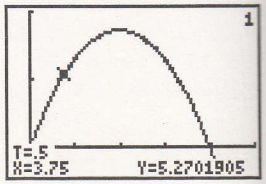
4. Press WINDOW. Press ▼ to move to **Tmin** and then enter the WINDOW variables appropriate for this problem.

Tmin=0	**Xmin=-2**	**Ymin=-2**
Tmax=3	**Xmax=25**	**Ymax=10**
Tstep=.02	**Xscl=5**	**Yscl=5**



5. Press TRACE to graph the position of the ball as a function of time.

   Tracing begins at **Tmin**. As you press ▶ to trace the curve, the cursor follows the path of the ball over time. The values for **X** (distance), **Y** (height), and **T** (time) are displayed at the bottom of the screen.



Defining and Displaying a Pa

Parametric equations component, each exp independent variable equations over time. equations can be def

Defining a Parametric Graph

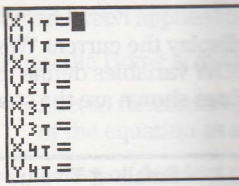
The steps for defining those for defining a fu below.

Setting Parametric Graph Modes

Press MODE *to display parametric equations,* WINDOW variables or equations. Also, you us obtain a more meaning

Displaying Parametric Equations

After selecting **Par** MO parametric Y= edit scr



On this screen, you dis components. TI-82 has terms of **T**.

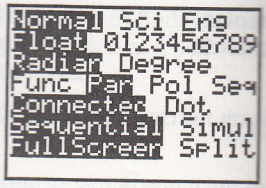
Defining Parametric Equations

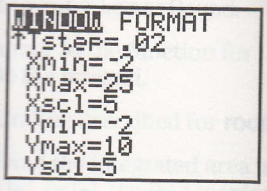
Follow the same proce the two components th equation.

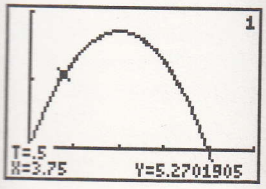
- You must define bo pair.
- The independent v may press X,T,Θ, n [T], to enter the pa defines the indepe

ction. Read the chapter for details.

scribes the position of a ball
velocity of 15 meters per second.
ximum height? When does the ball







Defining and Displaying a Parametric Graph

Parametric equations consist of an X component and a Y component, each expressed in terms of the same independent variable T. They are often used to graph equations over time. Up to six pairs of parametric equations can be defined and graphed at a time.

Defining a Parametric Graph

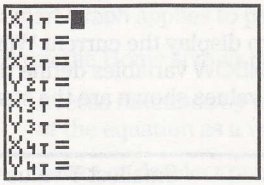
The steps for defining a parametric graph are the same as those for defining a function graph. Differences are noted below.

Setting Parametric Graph Modes

Press MODE to display the MODE settings. To graph parametric equations, you must select **Par** before you enter WINDOW variables or enter the components of parametric equations. Also, you usually should select **Connected** to obtain a more meaningful **Par** graph.

Displaying Parametric Equations

After selecting **Par** MODE, press Y= to display the parametric Y= edit screen.



On this screen, you display and enter both **X** and **Y** components. TI-82 has six equations, each defined in terms of **T**.

Defining Parametric Equations

Follow the same procedures as for **Func** graphing to enter the two components that define a new parametric equation.

- You must define both the **X** and **Y** components in a pair.
- The independent variable in each component is **T**. You may press X,T,Θ, rather than pressing ALPHA [T], to enter the parametric variable **T**. (**Par** MODE defines the independent variable as **T**.)

Selecting Parametric Equations

Only the selected parametric equations are graphed. The = sign on both components of selected equations is highlighted. You may select any or all of the equations on the parametric Y= edit screen.

To change the selection status of a parametric equation, press ◀ to move the cursor onto the = sign on either the **X** or **Y** component and press ENTER. The status on both the **X** and **Y** components is changed.

Note: When you enter both components of an equation or edit either component, that equation is selected automatically.

Setting WINDOW Variables

Press WINDOW to display the current WINDOW variable values. The WINDOW variables define the viewing WINDOW. The values shown are the standard values in **Radian** MODE.

`Tmin=0`	Smallest **T** value to evaluate
`Tmax=6.2831853...`	Largest **T** value to evaluate (2π)
`Tstep=.1308996...`	**T** value increment ($\pi/24$)
`Xmin=-10`	Smallest **X** value to be displayed
`Xmax=10`	Largest **X** value to be displayed
`Xscl=1`	Spacing between **X** tick marks
`Ymin=-10`	Smallest **Y** value to be displayed
`Ymax=10`	Largest **Y** value to be displayed
`Yscl=1`	Spacing between **Y** tick marks

You may want to change the **T** WINDOW variable values to ensure that sufficient points are plotted.

tric equations are graphed. The =
of selected equations is
ct any or all of the equations on
reen.

tatus of a parametric equation,
or onto the = sign on either the X
s ENTER. The status on both the X
ged.

th components of an equation or
at equation is selected

he current WINDOW variable
ables define the viewing
wn are the standard values in

allest **T** value to evaluate
gest **T** value to evaluate (2π)
alue increment ($\pi/24$)
allest **X** value to be displayed
gest **X** value to be displayed
cing between **X** tick marks
allest **Y** value to be displayed
gest **Y** value to be displayed
cing between **Y** tick marks

he **T** WINDOW variable values to
s are plotted.

Setting the WINDOW FORMAT

Press WINDOW ▶ to display the current WINDOW FORMAT settings. The formats are shared with the other graphing modes.

Displaying a Graph

When you press GRAPH, the TI-82 plots the selected parametric equations. It evaluates both the **X** and the **Y** component for each value of **T** (from **Tmin** to **Tmax** in intervals of **Tstep**) and then plots each point defined by **X** and **Y**. The WINDOW variables define the viewing WINDOW.

As a graph is plotted, the TI-82 updates **X**, **Y**, and **T**.

Smart Graph applies to parametric graphs.

WINDOW Variables and Y-VARS Menus

From the Home screen, you can:

- Access functions by using the name of the component of the equation as a variable.
- Select or deselect parametric equations from a program.
- Store parametric equations.
- Store values directly to WINDOW variables.

Exploring a Parametric Graph

As in Function graphing, three tools are available for exploring a graph: using the free-moving cursor, tracing an equation, and zooming.

Free-Moving Cursor

The free-moving cursor works in **Par** graphing just as it does in **Func** graphing. In **RectGC** FORMAT, moving the cursor updates and displays (if FORMAT is **CoordOn**) the values of **X** and **Y**. (In **PolarGC** FORMAT, **X**, **Y**, **R**, and θ are updated, and **R** and θ are displayed.)

TRACE

TRACE lets you move the cursor along the equation one **Tstep** at a time. When you begin a trace, the cursor is on the first selected equation at **Tmin**. The number of the equation shows in the upper right of the display.

In **RectGC** FORMAT, TRACE updates and displays (if FORMAT is **CoordOn**) the values of **X**, **Y**, and **T**. (In **PolarGC** FORMAT, **X**, **Y**, **R**, θ and **T** are updated, and **R**, θ, and **T** are displayed.) The **X** and **Y** (or **R** and θ) values are calculated from **T**.

If the cursor moves off the top or bottom of the screen, the coordinate values at the bottom of the screen continue to change appropriately.

2nd ◀ and 2nd ▶ move the TRACE cursor five plotted points at a time. The TRACE cursor remains in the same location if you leave TRACE and return, if Smart Graph has not caused the graph to be replotted.

QuickZoom is available in **Par** graphing, but panning is not.

ZOOM

ZOOM operations work in **Par** graphing as they do in **Func** graphing. Only the **X** (**Xmin**, **Xmax**, and **Xscl**) and **Y** (**Ymin**, **Ymax**, and **Yscl**) WINDOW variables are affected. **T** WINDOW variables (**Tmin**, **Tmax**, and **Tstep**) are not affected, except when you select **ZStandard** (**Tmin** = 0, **Tmax** = 2π, and **Tstep** = π/24). ZOOM MEMORY variables in **Par** graphing include **ZTmin**, **ZTmax**, and **ZTstep**.

CALC

CALC operations work in **Par** graphing as they do in **Func** graphing. CALC operations available in **Par** graphing are **value**, **dy/dx**, **dy/dt**, and **dx/dt**.

Chapter 5: Polar Graphing

This chapter descri the TI-82. Before d familiar with Chapt

Chapter Contents
Getting Started: Pola
Defining and Display
Exploring a Polar Gr

Chapter 5: Polar Graphing

This chapter describes how to graph polar equations on the TI-82. Before doing polar graphing, you should be familiar with Chapter 3, Function Graphing.

Chapter Contents

Getting Started: Polar Rose	. . . . .	5-2
Defining and Displaying a Polar Graph	. . . . .	5-3
Exploring a Polar Graph	. . . . .	5-6

Getting Started: Polar Rose

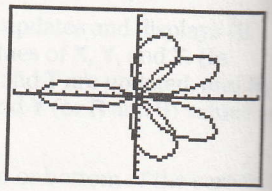
Getting Started is a fast-paced introduction. Read the chapter for details.

The polar equation A sin Bθ graphs a rose. Graph the rose for A=8 and B=2.5, then explore the appearance of the rose for other values of A and B.

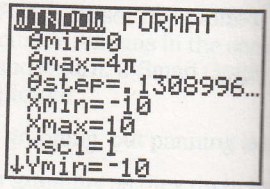
1. Press [MODE]. Press [▼] [▼] [▼] [▶] [▶] [ENTER] to select **Pol** MODE. Choose the initial settings for the other modes (the choice at the beginning of each line).

2. Press [Y=] to display the polar Y= edit screen. Press **8** [SIN] **2.5** [X,T,Θ] [ENTER] to define **r1**.

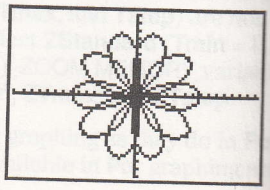
3. Press [ZOOM] **6** to select **ZStandard** to graph the equation in the standard viewing WINDOW. Notice that the graph shows only five petals of the rose and that the rose does not appear symmetrical. This is because the standard WINDOW defines the WINDOW, rather than the pixels, as square and sets **θmax=2π**.



4. Press [WINDOW] to display the WINDOW settings. Press [▼] [▼] **4** [2nd] [π] to increase the value of **θmax**.



5. Press [ZOOM] **5** to select **ZSquare** and plot the graph.



6. Continue, changing **A** and **B** to other values.

Defining and Displaying

Polar equations
variable θ. Up to
graphed at a tim

Defining a Polar Graph

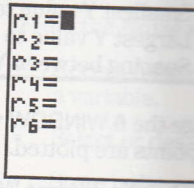
The steps for def
for defining a fun

Setting Polar Graph Modes

Press [MODE] to dis
equations, you m
variables or enter
should select **Co**
graph.

Displaying Polar Equations

After selecting **Po**
Y= edit screen.



On this screen, yo
TI-82 has six equa

Defining Polar Equations

Follow the same p
define a new polar
polar equation is θ
pressing [ALPHA] [θ]
MODE defines the

Selecting Polar Equations

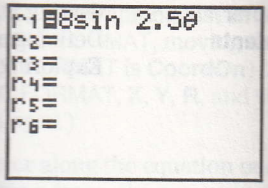
Only the selected p
on selected equatio
all of the equations

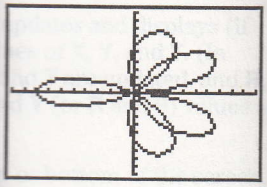
To change the sele
to move the cursor

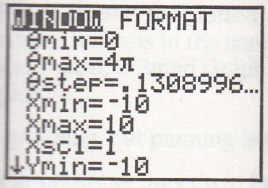
Note: When you ed
automatically.

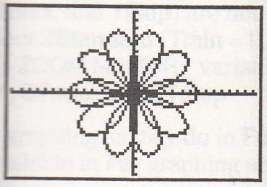
on. Read the chapter for details.

e. Graph the rose for A=8 and
e rose for other values of









Defining and Displaying a Polar Graph

Polar equations are defined in terms of the independent variable θ. Up to six polar equations can be defined and graphed at a time.

Defining a Polar Graph

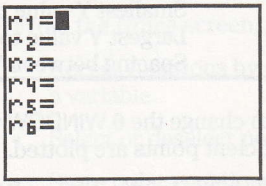
The steps for defining a polar graph are the same as those for defining a function graph. Differences are noted below.

Setting Polar Graph Modes

Press [MODE] to display the MODE settings. To graph polar equations, you must select **Pol** before you enter WINDOW variables or enter a polar equation. Also, you usually should select **Connected** to obtain a more meaningful **Pol** graph.

Displaying Polar Equations

After selecting **Pol** MODE, press [Y=] to display the polar Y= edit screen.



On this screen, you display and enter polar equations. The TI-82 has six equations, each defined in terms of θ.

Defining Polar Equations

Follow the same procedures as for **Func** graphing to define a new polar equation. The independent variable in a polar equation is θ. You may press [X,T,Θ], rather than pressing [ALPHA] [θ], to enter the polar variable θ. (**Pol** MODE defines the independent variable as θ.)

Selecting Polar Equations

Only the selected polar equations are graphed. The = sign on selected equations is highlighted. You may select any or all of the equations on the polar Y= edit screen.

To change the selection status of a polar equation, press [◀] to move the cursor onto the = sign and press [ENTER].

Note: When you edit an equation, that equation is selected automatically.

Setting WINDOW Variables

Press WINDOW to display the current WINDOW variable values. The WINDOW variables define the viewing WINDOW. The values shown are the standard values in **Radian** MODE.

θmin=0	Smallest θ value to be evaluated
θmax=6.2831853...	Largest θ value to evaluate (2π)
θstep=.1308996...	Increment between θ values (π/24)
Xmin=-10	Smallest **X** value to be displayed
Xmax=10	Largest **X** value to be displayed
Xscl=1	Spacing between **X** tick marks
Ymin=-10	Smallest **Y** value to be displayed
Ymax=10	Largest **Y** value to be displayed
Yscl=1	Spacing between **Y** tick marks

You may want to change the θ WINDOW variable values to ensure that sufficient points are plotted.

Setting the WINDOW FORMAT

Press WINDOW ▶ to display the current WINDOW FORMAT settings. The formats are shared with the other graphing modes.

the current WINDOW variable
riables define the viewing
own are the standard values in

nallest θ value to be evaluated
rgest θ value to evaluate (2π)
crement between θ values (π/24)
nallest **X** value to be displayed
rgest **X** value to be displayed
acing between **X** tick marks
nallest **Y** value to be displayed
rgest **Y** value to be displayed
acing between **Y** tick marks

the θ WINDOW variable values to
its are plotted.

y the current WINDOW FORMAT
shared with the other graphing

Displaying a Graph

When you press GRAPH, the TI-82 plots the selected polar equations. It evaluates **R** for each value of θ (from **θmin** to **θmax** in intervals of **θstep**) and then plots each point.

As a graph is plotted, the TI-82 updates **X**, **Y**, **R**, and θ.

Smart Graph applies to polar graphs.

Note that the free-moving cursor displays **X** and **Y** coordinate values if the WINDOW FORMAT setting is the default **RectGC**. To see **R** and θ, select **PolarGC** WINDOW FORMAT.

WINDOW Variables and VARS Menus

From the Home screen, you can:

- Access functions by using the name of the equation as a variable.
- Select or deselect polar equations from a program.
- Store polar equations.
- Store values directly to WINDOW variables.

Exploring a Polar Graph

As in function graphing, three tools are available for exploring a graph: using the free-moving cursor, tracing an equation, and zooming.

Free-Moving Cursor

The free-moving cursor works in **Pol** graphing just as it does in **Func** graphing. In **RectGC** FORMAT, moving the cursor updates and displays (if FORMAT is **CoordOn**) the values of **X** and **Y**. (In **PolarGC** FORMAT, **X**, **Y**, **R**, and θ are updated, and **R** and θ are displayed.)

TRACE

TRACE lets you move the cursor along the equation one **θstep** at a time. When you begin a trace, the cursor is on the first selected equation at **θmin**. The number of the equation shows in the upper right of the display.

In **RectGC** FORMAT, TRACE updates and displays (if FORMAT is **CoordOn**) the values of **X**, **Y**, and θ. (In **PolarGC** FORMAT, **X**, **Y**, **R**, and θ are updated, and **R** and θ are displayed.)

If the cursor moves off the top or bottom of the screen, the coordinate values at the bottom of the screen continue to change appropriately.

2nd ◀ and 2nd ▶ move the TRACE cursor five plotted points at a time. The TRACE cursor remains in the same location if you leave TRACE and return, if Smart Graph has not caused the graph to be replotted.

QuickZoom is available in **Pol** graphing, but panning is not.

ZOOM

ZOOM operations work in **Pol** graphing as they do in **Func** graphing. Only the **X** (**Xmin**, **Xmax**, and **Xscl**) and **Y** (**Ymin**, **Ymax**, and **Yscl**) WINDOW variables are affected. The θ WINDOW variables (**θmin**, **θmax**, and **θstep**) are not affected, except when you select **ZStandard** (**θmin** = 0, **θmax** = 2π, and **θstep** = $\pi/24$). The ZOOM MEMORY variables in **Pol** graphing include **Zθmin**, **Zθmax**, and **Zθstep**.

CALC

CALC operations work in **Pol** graphing as they do in **Func** graphing. The CALC operations available in **Pol** graphing are **value**, **dy/dx**, and **dr/dθ**.

Chapter 6: Sequence G

This chapter
TI-82. Before
familiar with

Chapter Contents

Getting Started
Defining and D
Exploring a Se

Chapter 6: Sequence Graphing

This chapter describes how to graph sequences on the TI-82. Before doing sequence graphing, you should be familiar with Chapter 3, Function Graphing.

Chapter Contents

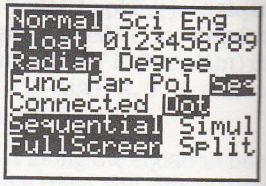
Getting Started: Forest and Trees 6-2
Defining and Displaying a Sequence Graph 6-3
Exploring a Sequence Graph 6-6

Getting Started: Forest and Trees

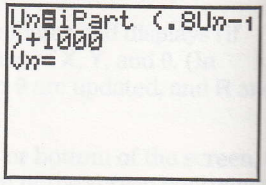
Getting Started is a fast-paced introduction. Read the chapter for details.

A small forest contains 4000 trees. The new forestry plan is that each year 20% of the trees will be harvested and 1000 new trees will be planted. Will the forest disappear? Does it stabilize at a certain number of trees? If so, what is that number?

1. Press MODE. Press ▼ ▼ ▼ ▶ ▶ ▶ ENTER to select **Seq** MODE. Press ▼ ▶ ENTER to select **Dot** MODE.



2. Press Y=. Each year the number of trees is 80 percent of what was there at the end of the prior year. Press MATH ▶ **2** (to select **iPart**, because the company will not harvest part of a tree) (**.8** 2nd [U_{n-1}] (2nd function of 7)) to define the number of trees after each harvest. Press + **1000** to define the replacement trees.

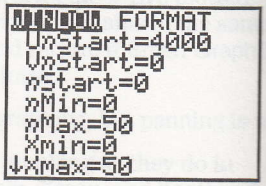


3. Press WINDOW. Press ▼ to move to **U*n*Start**. Press **4000** ENTER to define the number of trees at the beginning of the program.

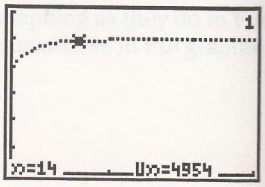
4. Press ▼ ▼ ▼ **50** ENTER to set ***n*Max=50** to plot the size of the forest over 50 years.

5. Set the other WINDOW variables:

   Xmin=0 **Ymin=0**
   Xmax=50 **Ymax=6000**
   Xscl=10 **Yscl=1000**



6. Press TRACE. Tracing begins at ***n*Min** (before the forestry program began). Press ▶ to trace the values year-by-year. The values for ***n*** (year) and **U*n*** (trees) are displayed at the bottom of the screen. How many years does it take to stabilize the size of the forest?



Defining and Displaying

There are two s
functions can b
variable (*n*) or t
(U*n-1* or V*n-1*). T
prior term in the

Defining a Sequence Graph

The basic steps
as those for defi
noted below.

Setting Sequence Graph Modes

Press MODE to dis
sequence functio
WINDOW variabl
may also want to
clearly. Note tha
Simul MODE, re

Displaying Sequence Functions

After selecting **S**
sequence Y= edit

On this screen, y
functions, **U*n*** an

Defining Sequence Functions

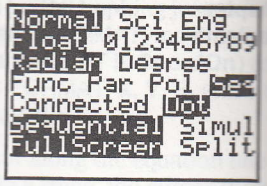
Follow the same
the expression th
nth term of **U*n*** o

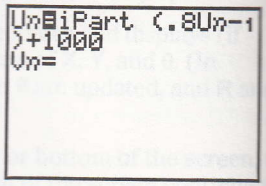
- Explicitly in t
  the 2nd functi
  X,T,Θ.)
- Recursively i
  using the vari
  7 and 8); fo
  U*n*=(1/2)U*n-1*

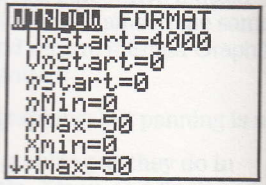
rees

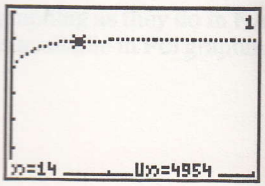
ction. Read the chapter for details.

e new forestry plan is that each
and 1000 new trees will be
es it stabilize at a certain number









Defining and Displaying a Sequence Graph

There are two sequence functions, U*n* and V*n*. Sequence functions can be defined in terms of the independent variable (*n*) or the prior item in the sequence function (U*n-1* or V*n-1*). They also can be defined in terms of the prior term in the other sequence function.

Defining a Sequence Graph

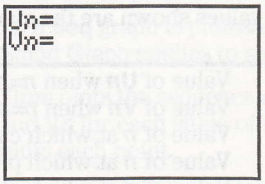
The basic steps for defining a sequence graph are the same as those for defining a function graph. Differences are noted below.

Setting Sequence Graph Modes

Press [MODE] to display the MODE settings. To graph sequence functions, you must select **Seq** before you enter WINDOW variables or enter the sequence functions. You may also want to select **Dot** to show discrete values more clearly. Note that sequence graphs automatically plot in **Simul** MODE, regardless of the current MODE setting.

Displaying Sequence Functions

After selecting **Seq** MODE, press [Y=] to display the sequence Y= edit screen.



On this screen, you display and enter the sequence functions, **U*n*** and **V*n***.

Defining Sequence Functions

Follow the same procedures as for **Func** graphing to enter the expression that defines a new sequence function. The *nth* term of **U*n*** or **V*n*** may be defined in one of two ways:

- Explicitly in terms of ***n***; for example, **Un=1/2^n**. (***n*** is the 2nd function of [9] on the keyboard, you cannot use [X,T,Θ].)
- Recursively in terms of the prior element in a sequence using the variables **Un-1** and **Vn-1** (the 2nd functions of [7] and [8]); for example, **Un=1/2^n** can be entered as **Un=(1/2)Un-1** for **UnStart=1**.

Selecting Sequence Functions

Only the selected sequence functions are graphed. On selected functions the = sign is highlighted. You may select one or both of the functions on the sequence Y= edit screen.

To change the selection status of a sequence function, press ◀ to move the cursor onto the = sign and press ENTER.

Note: When you enter or edit either function, that function is selected automatically.

Setting the WINDOW Variables

Press WINDOW to display the current WINDOW variable values. The WINDOW variables define the viewing WINDOW. The values shown are the standard defaults.

U*n*Start=0	Value of **U*n*** when ***n*=*n*Start**
V*n*Start=0	Value of **V*n*** when ***n*=*n*Start**
*n*Start=0	Value of ***n*** at which calculation begins
*n*Min=0	Value of ***n*** at which plotting begins
*n*Max=10	Value of ***n*** at which plotting ends
Xmin=-10	Smallest **X** value to be displayed
Xmax=10	Largest **X** value to be displayed
Xscl=1	Spacing between **X** tick marks
Ymin=-10	Smallest **Y** value to be displayed
Ymax=10	Largest **Y** value to be displayed
Yscl=1	Spacing between **Y** tick marks

Note: If **U*n*** or **V*n*** is nonrecursive (not defined in terms of **U*n*-1** or **V*n*-1**), then ***n*Min** should not be **0** in **Time** FORMAT. ***n*Min** should usually equal ***n*Start** +1 to obtain a meaningful graph.

Setting WINDOW FORMAT

Press WINDOW ▶ to
settings. Sequence
or **Web**. The other
graphing modes. P

```
WINDOW  FORMAT
Time    Web
RectGC  PolarGC
CoordOn CoordO
GridOff GridOn
AxesOn  AxesOff
LabelOff Label
```

Displaying a Graph

As a **Seq** graph is p
Smart Graph applie

Time plots the sequ
and **V*n*** for each va
plots each point.

Web calculates **U*n***
plots **U*n*-1** and **V*n*-1**
horizontal axis and
the vertical axis. Th

Evaluating U*n* and V*n*

From the Y-VARS m
names **U*n*** and **V*n*** to

- Calculate the *n*t
- Calculate a list o
- Generate a sequ

nstep is optional
Note: **U*n*** and **V*n***

```
"n²"→Un:Un(3)
Un({1,3,5,7,9
   {1 9 25 49
Un(1,9,2)
   {1 9 25 49
```

ice functions are graphed. On
sign is highlighted. You may select
ons on the sequence Y= edit

status of a sequence function,
sor onto the = sign and press

r edit either function, that function

the current WINDOW variable
riables define the viewing
own are the standard defaults.

of **U***n* when ***n*=*n*Start**
of **V***n* when ***n*=*n*Start**
of ***n*** at which calculation begins
of ***n*** at which plotting begins
of ***n*** at which plotting ends
st **X** value to be displayed
t **X** value to be displayed
g between **X** tick marks
st **Y** value to be displayed
t **Y** value to be displayed
g between **Y** tick marks

ecursive (not defined in terms of
should not be **0** in **Time** FORMAT.
l ***n*Start** +1 to obtain a meaningful

Setting WINDOW FORMAT

Press [WINDOW] [▶] to display the current WINDOW FORMAT settings. Sequence graphing has one unique format, **Time** or **Web**. The other formats are shared with the other graphing modes. **PolarGC** is not valid in **Time** FORMAT.

WINDOW FORMAT		
Time	Web	Sets type of sequence plot
RectGC	PolarGC	Sets rectangular or polar cursor
CoordOn	CoordOff	Sets cursor coordinate on or off
GridOff	GridOn	Sets grid off or on
AxesOn	AxesOff	Sets axes on or off
LabelOff	LabelOn	Sets axes label off or on

Displaying a Graph

As a **Seq** graph is plotted, the TI-82 updates **X**, **Y**, and ***n***. Smart Graph applies to sequence graphs.

Time plots the sequence as a function of ***n***. It evaluates **U***n* and **V***n* for each value of ***n*** (from ***n*Min** to ***n*Max** by **1**) and plots each point.

Web calculates **U***n* and **V***n* as functions of **U***n-1* and **V***n-1*. It plots **U***n-1* and **V***n-1* (independent variables) on the horizontal axis and **U***n* and **V***n* (dependent variables) on the vertical axis. The line **Y=X** is plotted automatically.

Evaluating U*n* and V*n*

From the Y-VARS menu, you can access the function names **U***n* and **V***n* to:

- Calculate the *n*th value in a sequence.
- Calculate a list of values in a sequence.
- Generate a sequence with **Un(***nstart*,*nstop*,*nstep*)**. *nstep* is optional (if not specified, *nstep*=1).
  Note: U*n* and **V***n* are invalid with **seq(**.

```
"n²"→Un:Un(3)
                    9
Un({1,3,5,7,9})
   {1 9 25 49 81}
Un(1,9,2)
   {1 9 25 49 81}
```

As in Function graphing, three tools are available for exploring a graph: using the free-moving cursor, tracing a function, and zooming.

Free-Moving Cursor

The free-moving cursor works in **Seq** graphing just as it does in **Func** graphing. In **RectGC** FORMAT, moving the cursor updates and displays (if FORMAT is **CoordOn**) the values of **X** and **Y**. (In **PolarGC** FORMAT, **X**, **Y**, **R**, and θ are updated, and **R** and θ are displayed.)

TRACE

In **Time** FORMAT, when you begin a trace, the cursor is on the first selected function at ***n*Min**. TRACE displays (if FORMAT is **CoordOn**) the values of **U*n*** or **V*n*** and ***n***. ▷ moves the cursor forward along the function one ***n*** at a time. It updates **U*n***, ***n***, **X**, and **Y**.

In **Web** FORMAT, the trail left by the TRACE cursor helps identify points with attracting and repelling behavior in the sequence. When you begin a trace, the cursor is on the **X** axis at the value of **U*n*start** or **V*n*start** (the first selected function). TRACE displays and updates (if FORMAT is **CoordOn**) the values of ***n***, **X**, and **Y** (or **R** and θ). **X** and **Y** (or **R** and θ) are calculated from ***n***. ▷ moves the cursor between the function and the graph of **Y=X**, displaying both for ***n*** before incrementing ***n***.

If the cursor moves off the top or bottom of the screen, the coordinate values at the bottom of the screen continue to change appropriately.

In **Seq**, ◁ or 2nd ◁ moves the TRACE cursor to ***n*=*n*Min**.

QuickZoom and panning are available in **Seq** graphing.

ZOOM

ZOOM operations works in **Seq** graphing as they do in **Func** graphing. Only the **X** (**Xmin**, **Xmax**, and **Xscl**) and **Y** (**Ymin**, **Ymax**, and **Yscl**) WINDOW variables are affected. **U*n*start**, **V*n*start**, ***n*Start**, ***n*Min**, and ***n*Max** are not affected, except when you select **ZStandard** (**U*n*Start=0**, **V*n*Start=0**, ***n*Start=0**, ***n*Min=0** and ***n*Max=10**). The ZOOM MEMORY variables in **Seq** graphing include **ZU*n*Start**, **ZV*n*Start**, **Z*n*Start**, **Z*n*Min**, and **Z*n*Max**.

CALC

value is the only CALC operation available in **Seq** graphing. It is not available in **Web** FORMAT.

This chapter describes

Chapter Contents

Getting Started: Roots o
Defining the Independer
Defining the Dependent
Displaying the Table . .

g, three tools are available for
g the free-moving cursor, tracing
g.

works in **Seq** graphing just as it
In **RectGC** FORMAT, moving the
lays (if FORMAT is **CoordOn**) the
olarGC FORMAT, **X**, **Y**, **R**, and θ are
e displayed.)

you begin a trace, the cursor is on
n at ***n*Min**. TRACE displays (if
ne values of **U*n*** or **V*n*** and ***n***.
rd along the function one ***n*** at a
, and **Y**.

il left by the TRACE cursor helps
acting and repelling behavior in the
in a trace, the cursor is on the **X**
art or **V*n*start** (the first selected
ys and updates (if FORMAT is
n, **X**, and **Y** (or **R** and θ). **X** and **Y**
ed from ***n***. moves the cursor
d the graph of **Y=X**, displaying
enting ***n***.

ne top or bottom of the screen, the
bottom of the screen continue to

es the TRACE cursor to ***n*=*n*Min**.

are available in **Seq** graphing.

in **Seq** graphing as they do in
X (**Xmin**, **Xmax**, and **Xscl**) and
) WINDOW variables are affected.
***n*Min**, and ***n*Max** are not affected,
Standard (**U*n*Start=0**, **V*n*Start=0**,
lax=10). The ZOOM MEMORY
include **ZU*n*Start**, **ZV*n*Start**,
ax.

peration available in **Seq**
le in **Web** FORMAT.

Chapter 7: Tables

This chapter describes how to use tables on the TI-82.

Chapter Contents

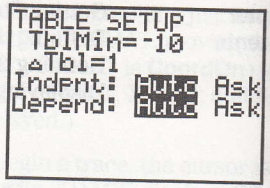
Getting Started: Roots of a Function 7-2
Defining the Independent Variable 7-3
Defining the Dependent Variable 7-4
Displaying the Table 7-5

Getting Started: Roots of a Function

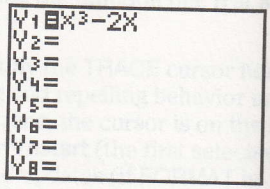
Getting Started is a fast-paced introduction. Read the chapter for details.

Evaluate the function $Y=X^3-2X$ at each integer between -10 and 10. How many sign changes are there and where do they occur?

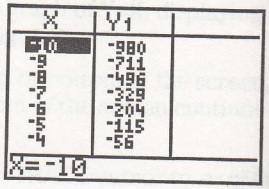
1. Press [2nd] [TblSet] to display the TABLE SETUP screen. Press [(-)] **10** to set **TblMin=-10**. Leave **ΔTbl=1**. Leave the independent and dependent value settings on **Auto**.



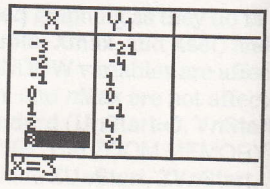
2. Press [Y=] [X,T,Θ] [MATH] **3** (to select ^{3}) [−] **2** [X,T,Θ] to enter the function **$Y_1=X^3-2X$**.



3. Press [2nd] [TABLE] to display the table screen.



4. Press [▼] until you see the sign changes in the value of **Y_1**.

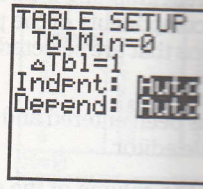


Defining the Variables

The independent variable in the cu the TABLE SETU

TABLE SETUP Screen

To display the TAB



TblMin and ΔTbl

TblMin (table minim (when the indepen generated). It defin variable: **X** (**Func**),

ΔTbl (table step) de independent variab

Note: In **Seq** MODE integers.

Indpnt: Auto or Ask

You can choose to d independent variabl at a time on the tabl values when the tab empty table and you

Depend: Auto or Ask

You can choose to d variables automatic and displays all tabl displayed. **Ask** displ independent variabl for a specific locatio

Setting Up a Table from the Home Screen or a Program

You can store values the Home screen or the VARS TABLE me the independent vari program editor, whe instructions for **Indp DependAsk**.

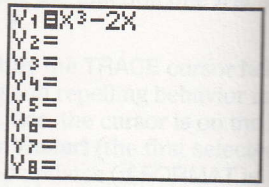
roduction. Read the chapter for details.

each integer between -10 and 10.
and where do they occur?

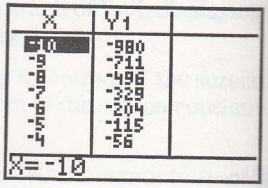
BLE

he

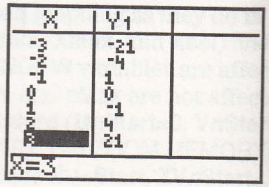
2
2X.



le



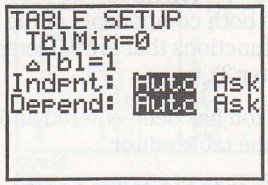
ges in



The independent variable for tables is the independent variable in the current graphing MODE. It is defined on the TABLE SETUP screen.

TABLE SETUP Screen

To display the TABLE SETUP screen, press 2nd [TblSet].



TblMin and ΔTbl

TblMin (table minimum) applies when **Indpnt** is **Auto** (when the independent variable is automatically generated). It defines the initial value for the independent variable: **X** (**Func**), **T** (**Par**), θ (**Pol**), and ***n*** (**Seq**).

ΔTbl (table step) defines the increment for the independent variable.

Note: In **Seq** MODE, **TblMin** and **ΔTbl** both must be integers.

Indpnt: Auto or Ask

You can choose to display a table of values for the independent variable automatically or enter the values one at a time on the table. **Auto** generates and displays the values when the table is first displayed. **Ask** displays an empty table and you enter the values.

Depend: Auto or Ask

You can choose to display the values for the dependent variables automatically or one at a time. **Auto** calculates and displays all table values when the table is first displayed. **Ask** displays a table without values for the independent variables. It calculates and displays a value for a specific location when you press ENTER.

Setting Up a Table from the Home Screen or a Program

You can store values to **TblMin**, **ΔTbl**, and **TblInput** from the Home screen or a program. The variable names are on the VARS TABLE menu. **TblInput** is a list of the values of the independent variable in the current table. In the program editor, when you press 2nd [TblSet], you can select instructions for **IndpntAuto**, **IndpntAsk**, **DependAuto**, or **DependAsk**.

Defining the Dependent Variable

The selected Y*n* functions define the dependent variables. You can have as many dependent variables as there are functions in the current graphing MODE.

From the Y= Editor

Enter the functions to define the dependent variables in the Y= editor. The current graphing MODE is used. In **Par**, you must define both components of the parametric equation. Only functions that are selected are displayed in the table (Chapter 3).

From the Table Editor

Once a Y= function has been entered and selected, you can change it from the table editor.

1. Move the cursor to the column of the dependent variable.
2. Press ▲ until the cursor is on the name of the function at the top of the column. The function is displayed on the bottom line.
3. You may edit the function. Press ENTER to switch to the editing context and make the changes. The function in the Y= table is updated.
4. Press ENTER or ▼. The new values are calculated, and the table is updated automatically.

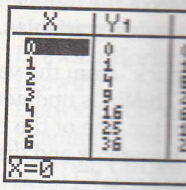
Note: This feature also allows you to view the function that defines the dependent variable(s) without leaving the table.

Displaying the Table

The table displa seven depender can use ◄, ▲, ► table, displaying dependent value

The Table

Press 2nd [TABLE



The top line displ and one or two de displays the full v the rectangular cu display the values variables.

The selections you determine which 2nd [TABLE].

Indpnt: Auto
Depend: Auto

Indpnt: Ask
Depend: Auto

Indpnt: Auto
Depend: Ask

Indpnt: Ask
Depend: Ask

Displaying the Table

The table displays two independent values for up to seven dependent values. Once the table is displayed, you can use ◄, ▲, ►, and ▼ to move around and scroll the table, displaying other independent variables and other dependent values.

The Table

Press 2nd [TABLE] to display the table screen.

X	Y1	Y2
0	0	0
1	1	1
2	4	8
3	9	27
4	16	64
5	25	125
6	36	216

X=0

The top line displays the name of the independent variable and one or two dependent variables. The bottom line displays the full value of the current cell, as indicated by the rectangular cursor. The center portion is used to display the values, abbreviated if necessary, of the variables.

The selections you made on the TABLE SETUP screen determine which cells contain values when you press 2nd [TABLE].

Indpnt: Auto **Depend: Auto**	Values appear in all cells in the table automatically.
Indpnt: Ask **Depend: Auto**	Table is empty. When a value is entered for the independent variable, the dependent values are calculated automatically.
Indpnt: Auto **Depend: Ask**	Values appear for the independent variable. To generate a value for a dependent variable, move to the specific cell and press ENTER.
Indpnt: Ask **Depend: Ask**	Table is empty. Enter values for independent variable. To generate a value for a dependent variable, move to the specific cell and press ENTER.

Displaying More Independent Values

If you selected **Indpnt: Auto**, you can use ▲ and ▼ to display additional values of the independent variable and the corresponding dependent variables.

Note: You can scroll "back" from the value entered for **TblMin**. As you scroll, **TblMin** is updated automatically to the value shown on the top line of the table. For example, **TblMin=0** and **ΔTbl=1** generates and displays values of **X**=0, . . ., 6, but you can press ▲ to scroll backwards and display the table for **X**=-1, . . ., 5.

X	Y1	Y2
-1	1	-1
0	0	0
1	1	1
2	4	8
3	9	27
4	16	64
5	25	125

X=-1

Displaying Other Dependent Variables

If you have more than two dependent variables defined, the first two in the Y= list are displayed. Press ▶ and ◀ to display other dependent variables.

X	Y2	Y3
-1	-1	1
0	0	0
1	1	1
2	8	16
3	27	81
4	64	256
5	125	625

Y3=1

Clearing the Table

From a program, select the **ClrTable** instruction from the PRGM I/O menu. If TblSet is **IndpntAsk**, all independent variable values and dependent variable values on the table are cleared. If TblSet is **DependAsk**, all dependent variable values on the table are cleared.

Chapter 8: DRAW Operatio

This chapter descr
of the TI-82. Before
should be familiar

Chapter Contents

Getting Started: Sha
DRAW DRAW Menu
Drawing Lines . . .
Drawing Horizontal
Drawing Tangent Li
Drawing Functions
Shading Areas on a
Drawing Circles . .
Placing Text on a Gr
Using Pen to Draw
Drawing Points . . .
Drawing Pixels . . .
Storing and Recallin
Storing and Recallin
Clearing a Drawing

Chapter 8: DRAW Operations

This chapter describes how to use the DRAW operations of the TI-82. Before using the DRAW operations, you should be familiar with Chapter 3, Function Graphing.

Chapter Contents

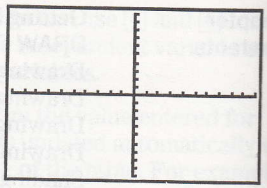
Getting Started: Shading a Graph	. . . . .	8-2
DRAW DRAW Menu	. . . . .	8-3
Drawing Lines	. . . . .	8-4
Drawing Horizontal and Vertical Lines	. . . . .	8-5
Drawing Tangent Lines	. . . . .	8-6
Drawing Functions and Inverses	. . . . .	8-7
Shading Areas on a Graph	. . . . .	8-8
Drawing Circles	. . . . .	8-9
Placing Text on a Graph	. . . . .	8-10
Using Pen to Draw on a Graph	. . . . .	8-11
Drawing Points	. . . . .	8-12
Drawing Pixels	. . . . .	8-13
Storing and Recalling Graph Pictures	. . . . .	8-14
Storing and Recalling Graph Databases	. . . . .	8-15
Clearing a Drawing	. . . . .	8-16

Getting Started: Shading a Graph

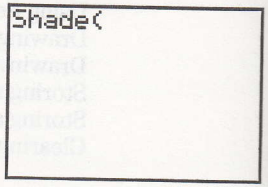
Getting Started is a fast-paced introduction. Read the chapter for details.

Shade the area above the function Y=X+1 and below the function $Y=X^3-8X$.

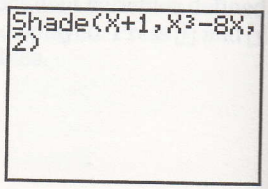
1. Press [Y=] to see that all functions are deselected.
2. Press [ZOOM] **6** to reset the graph screen to the standard viewing WINDOW, clear any existing drawings, and display the viewing window.



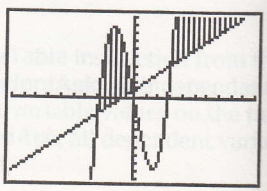
3. Press [2nd] [DRAW] and press **7** to select **Shade(**, which is copied to the Home screen.



4. Press [X,T,Θ] [+] **1** [,] to define the function above which you want to shade.
5. Press [X,T,Θ] [MATH] **3** (to select ^{3}) [−] **8** [X,T,Θ] [,] to define the function below which you want to shade.
6. Press **2** [)] to define the resolution for shading the graph.



7. Press [ENTER] to execute the instruction. The two functions are drawn and the specified area shaded.



DRAW DRAW Menu

To display the
What happens
dependent on
you access th
operation.

DRAW DRAW Menu

```
DRAW POINTS
1:ClrDraw
2:Line(
3:Horizonta
4:Vertical
5:Tangent(
6:DrawF
7:Shade(
8:DrawInv
9:Circle(
0:Text(
A:Pen
```

See page 8-16 f

Before Drawing on a Graph

Because DRAW currently select more of the foll

- Change the
- Change the
- Enter or edit
- Select or des
- Change WIN
- Turn Stat Plo
- Clear existing

Drawing on a Graph

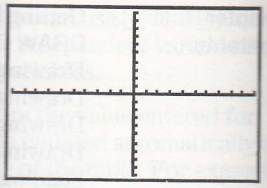
DRAW operation graphs, except D graphing. The co always the X-coo display.

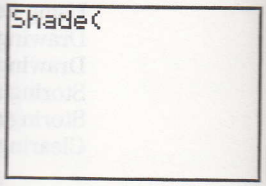
You can use mos operations to dra identify coordina from the Home s displayed when y screen is displaye

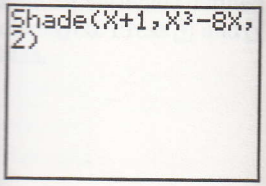
ph

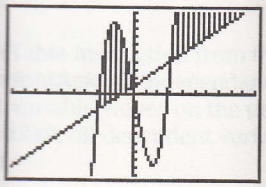
ion. Read the chapter for details.

1 and below the function









DRAW DRAW Menu

To display the DRAW DRAW menu, press 2nd [DRAW]. What happens when you select an item from this menu is dependent on whether or not a graph is displayed when you access the menu, as described under each operation.

DRAW DRAW Menu

DRAW POINTS STO	
1:ClrDraw	Clears all drawn elements
2:Line(	Draws a line between two points
3:Horizontal	Draws a horizontal line
4:Vertical	Draws a vertical line
5:Tangent(	Draws a line tangent to a function
6:DrawF	Draws a function
7:Shade(	Shades an area
8:DrawInv	Draws the inverse of a function
9:Circle(	Draws a circle
0:Text(	Annotates a graph with text
A:Pen	Free-form drawing tool

See page 8-16 for **ClrDraw**.

Before Drawing on a Graph

Because DRAW operations draw on top of the graph of currently selected functions, you may want to do one or more of the following before drawing on a graph:

- Change the MODE settings.
- Change the WINDOW FORMAT settings.
- Enter or edit functions in the Y= list.
- Select or deselect functions in the Y= list.
- Change WINDOW variable values.
- Turn Stat Plots on or off.
- Clear existing drawings with **ClrDraw** (page 8-16).

Drawing on a Graph

DRAW operations can draw on **Func**, **Par**, **Pol**, and **Seq** graphs, except **DrawInv**, which is valid only in **Func** graphing. The coordinates for all DRAW instructions are always the **X**-coordinate and **Y**-coordinate values of the display.

You can use most of the DRAW DRAW and DRAW POINTS operations to draw directly on a graph using the cursor to identify coordinates, or you can execute these instructions from the Home screen or a program. If a graph is not displayed when you select a DRAW operation, the Home screen is displayed automatically.

Drawing Lines

While a graph is displayed, Line(lets you define a line on the graph using the cursor. If a graph is not displayed, the instruction is copied to the Home screen.

Directly on a Graph

1. When a graph is displayed, select **Line(** from the DRAW DRAW menu (item 2).
2. Position the cursor at the beginning point of the line you want to draw. Press [ENTER].
3. Move the cursor to the end point of the line you want to draw. The line is displayed as you move the cursor. Press [ENTER].

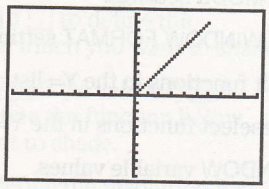
To continue to draw lines, repeat steps 2 and 3. To cancel **Line(**, press [CLEAR].

From the Home Screen or a Program

Line((DRAW DRAW item 2) draws a line between the coordinates (*X1*,*Y1*) and (*X2*,*Y2*). The values may be entered as expressions.

Line(*X1*,*Y1*,*X2*,*Y2***)**

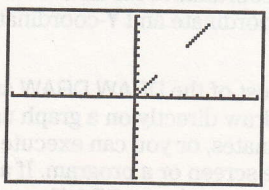
For example, **Line(0,0,6,9)** displays:



To erase a line:

Line(*X1*,*Y1*,*X2*,*Y2*,**0)**

For example, **Line(2,3,4,6,0)** following the instruction above displays:



Drawing Horizontal and V

**While a graph is
you define lines
is not displayed,
screen.**

Directly on a Graph

1. When a graph
Vertical (item
2. A line is displa
Position the cu
Press [ENTER]. T

To continue to dra
Horizontal or **Verti**

From the Home Screen or a Program

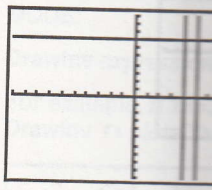
Horizontal (horizo
horizontal line at **Y**
not a list).

Horizontal *Y*

Vertical (vertical li
vertical line at **X**=*X*
list).

Vertical *X*

For example, **Horiz**



Drawing Horizontal and Vertical Lines

While a graph is displayed, Horizontal and Vertical let you define lines on the graph using the cursor. If a graph is not displayed, the instruction is copied to the Home screen.

Directly on a Graph

1. When a graph is displayed, select **Horizontal** (item 3) or **Vertical** (item 4) from the DRAW DRAW menu.
2. A line is displayed that moves as you move the cursor. Position the cursor where you want to draw the line. Press ENTER. The line is drawn on the graph.

To continue to draw lines, repeat step 2. To cancel **Horizontal** or **Vertical**, press CLEAR.

From the Home Screen or a Program

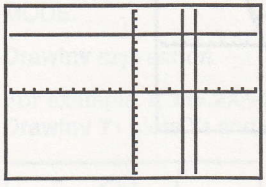
Horizontal (horizontal line) (DRAW DRAW item 3) draws a horizontal line at **Y**=*Y* (which can be an expression, but not a list).

Horizontal *Y*

Vertical (vertical line) (DRAW DRAW item 4) draws a vertical line at **X**=*X* (which can be an expression, but not a list).

Vertical *X*

For example, **Horizontal 7:Vertical 4:Vertical 5** displays:



Drawing Tangent Lines

While a graph is displayed, you can draw the tangent line of a function at a specified point using the cursor. If a graph is not displayed, the instruction is copied to the Home screen.

Directly on a Graph

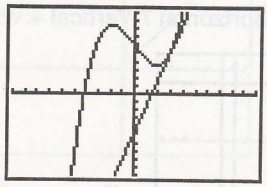
1. When a graph of selected functions is displayed, select **Tangent(** from the DRAW DRAW menu (item 5).
2. Use ▼ and ▲ to move the cursor to the function for which you want to draw the tangent line.
3. Use ▶ and ◀ to move the cursor to the point on the function at which you want to draw the tangent line.
4. Press ENTER.

From the Home Screen or a Program

Tangent((tangent line) (DRAW DRAW item 5) draws a line tangent to an *expression* in terms of **X** (such as **Y1** or **X2**) at point **X**=*value* (which can be an expression). *expression* is interpreted as being in **Func** MODE.

Tangent(*expression*,*value*)

For example, if **Y1=.2X3–2X+6** is the only selected function, **Tangent(Y1,3)** plots **Y1** and draws the tangent to the function at **X**=3:



Drawing Functions and Inv

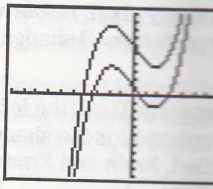
DrawF (draw funct graph. DrawInv (d function on the cu entered on the Ho

Drawing a Function

DrawF (draw funct interactive operatio terms of **X** on the c

DrawF *expression*

For example, if **Y1=** **DrawF Y1–5** plots **Y**



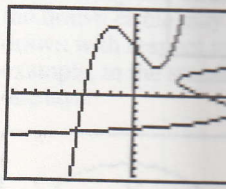
Note: A list cannot b of curves.

Drawing an Inverse of a Function

DrawInv (draw inver interactive operation in terms of **X** on the MODE.

DrawInv *expression*

For example, if **Y1=.2** **DrawInv Y1** plots **Y1**



splayed, you can draw the tangent line pecified point using the cursor. If a yed, the instruction is copied to the

selected functions is displayed, select he DRAW DRAW menu (item 5).

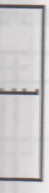
move the cursor to the function for to draw the tangent line.

move the cursor to the point on the h you want to draw the tangent line.

ne) (DRAW DRAW item 5) draws a line *ssion* in terms of **X** (such as **Y1** or **X²**) hich can be an expression). *expression* ng in **Func** MODE.

,value)

2X³–2X+6 is the only selected 1,3) plots **Y1** and draws the tangent to



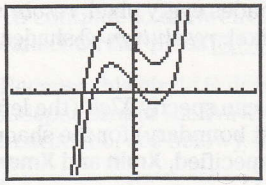
DrawF (draw function) draws a function on the current graph. DrawInv (draw inverse) draws an inverse of a function on the current graph. Both instructions must be entered on the Home screen or in the program editor.

Drawing a Function

DrawF (draw function) (DRAW DRAW item 6) is not an interactive operation. It draws *expression* as a function in terms of **X** on the current graph.

DrawF *expression*

For example, if **Y1=.2X³–2X+6** is the only selected function, **DrawF Y1–5** plots **Y1** and draws the function **Y1–5**:



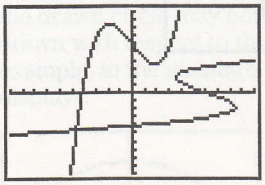
Note: A list cannot be used in *expression* to draw a family of curves.

Drawing an Inverse of a Function

DrawInv (draw inverse) (DRAW DRAW item 8) is not an interactive operation. It draws the inverse of an *expression* in terms of **X** on the current graph. You must be in **Func** MODE.

DrawInv *expression*

For example, if **Y1=.2X³–2X+6** is the only selected function, **DrawInv Y1** plots **Y1** and draws its inverse:



Shading Areas on a Graph

Shade(shades the area on a graph that is both below one specified function and above another, between two X values. The instruction must be entered on the Home screen or in the program editor.

Shading a Graph

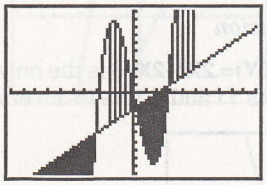
Shade((DRAW DRAW item 7) is not an interactive operation. It draws *lowerfunc* and *upperfunc* in terms of **X** on the current graph and shades the area that is specifically above *lowerfunc* and below *upperfunc*. Only the areas where *lowerfunc* < *upperfunc* are shaded.

You can specify the shading *resolution* (an integer between 1 and 9). If none is specified, 1 is used. *resolution*=1 shades every pixel. *resolution*=2 shades every second pixel. *resolution*=3 shades every third pixel, and so on.

Optionally, you can specify *Xleft* (the left boundary) and *Xright* (the right boundary) for the shaded area. If *Xleft* or *Xright* are not specified, **Xmin** and **Xmax** are used.

Shade(*lowerfunc*,*upperfunc***)**
Shade(*lowerfunc*,*upperfunc*,*resolution***)**
Shade(*lowerfunc*,*upperfunc*,*resolution*,*Xleft***)**
Shade(*lowerfunc*,*upperfunc*,*resolution*,*Xleft*,*Xright***)**

For example, **Shade(X³–8X,X–2):Shade(X–2,X³–8X,2,-2,5)** displays:



Drawing Circles

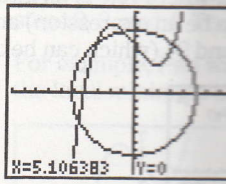
While a graph is dis on the graph using the instruction is co

Directly on a Graph

1. When a graph is DRAW DRAW me
2. Position the curs to draw. Press [EN
3. Move the cursor [ENTER]. The circle

To continue to draw cancel **Circle(** press

Because this circle is independent of the W instruction, see belo

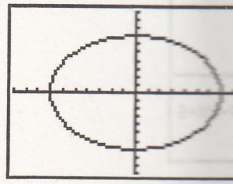


From the Home Screen or a Program

Circle((DRAW DRAW
(*X*,*Y*) and *radius* (the

Circle(*X*,*Y*,*radius***)**

Note: When the **Circl** the drawn circle may drawn with respect to example, in the stand displays:



a graph that is both below above another, between two X st be entered on the Home ditor.

7) is not an interactive ic and *upperfunc* in terms of X ades the area that is c and below *upperfunc*. Only < *upperfunc* are shaded.

resolution (an integer specified, 1 is used. ixel. *resolution*=2 shades n=3 shades every third pixel.

Xleft (the left boundary) and for the shaded area. If *Xleft* or in and **Xmax** are used.

)
,*resolution*)
,*resolution*,*Xleft*)
,*resolution*,*Xleft*,*Xright*)

X–2):Shade(X–2,X^3–8X,2,-2,5)

Drawing Circles

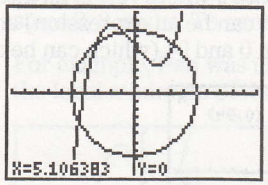
While a graph is displayed, Circle(lets you define a circle on the graph using the cursor. If a graph is not displayed, the instruction is copied to the Home screen.

Directly on a Graph

1. When a graph is displayed, select **Circle(** from the DRAW DRAW menu (item 9).
2. Position the cursor at the center of the circle you want to draw. Press [ENTER].
3. Move the cursor to a point on the circumference. Press [ENTER]. The circle is drawn on the graph.

To continue to draw circles, repeat steps 2 and 3. To cancel **Circle(** press [CLEAR].

Because this circle is drawn on the display and is independent of the WINDOW values (unlike the **Circle(** instruction, see below), it appears as a circle.

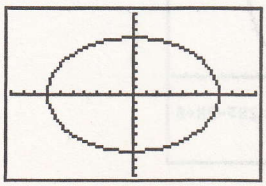


From the Home Screen or a Program

Circle((DRAW DRAW item 9) draws a circle with center (*X*,*Y*) and *radius* (these values can be expressions).

Circle(*X*,*Y*,*radius***)**

Note: When the **Circle(** instruction is used from a program, the drawn circle may not look like a circle because it is drawn with respect to the current WINDOW values. For example, in the standard viewing WINDOW, **Circle(0,0,7)** displays:



Placing Text on a Graph

While a graph is displayed, Text(lets you place text on it. If a graph is not displayed, the instruction Text(is copied to the Home screen.

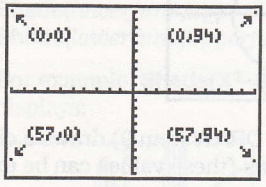
Directly on a Graph

1. When a graph is displayed, select **Text(** from the DRAW DRAW menu.
2. Position the cursor where you want the text to begin.
3. Type the characters. You may enter TI-82 functions and instructions. The font is proportional, so the exact number of characters you can place is variable. As you type, the characters are placed on top of the graph.

To cancel **Text(**, press [CLEAR].

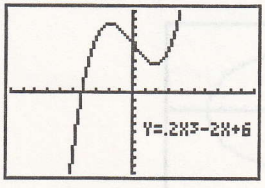
From the Home Screen or a Program

Text((DRAW DRAW item 0) places the characters in *text* (which can include TI-82 functions and instructions) on the current graph. The upper left of the first character is at pixel (*row*,*column*), where *row* is an integer between 0 and 57 (which can be an expression) and *column* is an integer between 0 and 94 (which can be an expression).



Text(*row*,*column*,*value*,*value* . . .**)**

value may be text enclosed in " marks or an expression, which will be evaluated and the result displayed with up to 10 characters. For example, if **Y1=.2X3–2X+6** is the only selected function, **Text(42,52,"Y=.2X3–2X+6=")** displays:



Split Screen

In **Split** screen MODE, the maximum value of *row* is 27.

Using Pen to Draw on a

While a graph the graph with

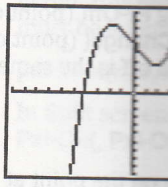
Using Pen

Pen draws dire Home screen o

1. When a gra DRAW men
2. Position the Press [ENTER]
3. As you mov on each poi
4. Press [ENTER] new positio

To continue to steps 2, 3, and

For example, P the local minim



Using Pen to Draw on a Graph

While a graph is displayed, Pen lets you draw directly on the graph with the cursor.

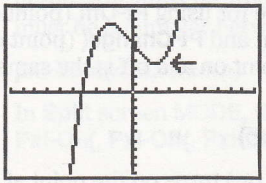
Using Pen

Pen draws directly on a graph. It is not accessible from the Home screen or a program.

1. When a graph is displayed, select **Pen** from the DRAW DRAW menu (item A).
2. Position the cursor where you want to begin drawing. Press [ENTER] to turn the pen on.
3. As you move the cursor, it draws on the graph, turning on each point that the cursor crosses.
4. Press [ENTER] to turn the pen off. Move the cursor to a new position where you want to begin drawing again.

To continue to draw on the graph with the pen, repeat steps 2, 3, and 4. To cancel **Pen**, press [CLEAR].

For example, **Pen** was used to create the arrow pointing to the local minimum of the selected function.



Drawing Points

To display the DRAW POINTS menu, press [2nd] [DRAW] ▶. What happens when you select an item from this menu is dependent on whether or not a graph is displayed when you access the menu, as described under each operation.

DRAW POINTS Menu

```
DRAW POINTS  STO
1:Pt-On(          Turn on a point
2:Pt-Off(         Turn off a point
3:Pt-Change(      Toggle a point on or off
4:Pxl-On(         Turn on a pixel
5:Pxl-Off(        Turn off a pixel
6:Pxl-Change(     Toggle a pixel on or off
7:pxl-Test(       Return 1 if pixel is on, 0 if off
```

Directly on a Graph

1. When a graph is displayed, select **Pt-On(** from the DRAW POINTS menu.
2. Position the cursor at the location on the display where you want to draw the point. Press [ENTER]. The point is drawn.

To continue to draw points, repeat step 2. To cancel **Pt-On(**, press [CLEAR].

Pt-Off(
Pt-Change(

The procedure for using **Pt-Off(** (point off) to turn off (erase) a point and **Pt-Change(** (point change) to toggle (reverse) a point on and off is the same as for **Pt-On**.

Pt-Off(*X*,*Y*)
Pt-Change(*X*,*Y*)

From the Home Screen or a Program

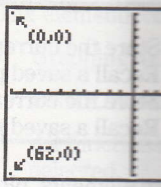
Pt-On((point on) turns on the point at (**X**=*X*,**Y**=*Y*).

Pt-On(*X*,*Y*)

Drawing Pixels

The Pxl (pixel) reverse a pixe instruction mu program edito

TI-82 Pixels



Turning Pixels On and Off

The pixel instru on) (DRAW PO (*row*,*column*), and *column* is

Pxl-On(*row*,*col*
Pxl-Off(*row*,*col*
Pxl-Change(*ro*

pxl-Test(

pxl-Test((pixel pixel (*row*,*colu* graph. *row* mus must be an inte

pxl-Test(*row*,*co*

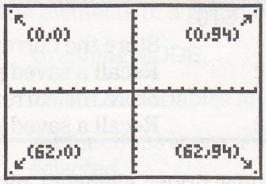
Split Screen

In **Split** screen **Pxl-On(**, **Pxl-Off**

Drawing Pixels

The Pxl (pixel) operations let you turn on, turn off, or reverse a pixel (a dot) on the graph using the cursor. The instruction must be entered on the Home screen or in the program editor.

TI-82 Pixels



Turning Pixels On and Off

The pixel instructions are not interactive. **Pxl-On(** (pixel on) (DRAW POINTS item 9) turns on the pixel at (*row*,*column*), where *row* is an integer between 0 and 62 and *column* is an integer between 0 and 94.

Pxl-On(*row*,*column*)
Pxl-Off(*row*,*column*)
Pxl-Change(*row*,*column*)

pxl-Test(

pxl-Test((pixel test) (DRAW POINTS item 7) returns 1 if a pixel (*row*,*column*) is On or 0 if it is Off on the current graph. *row* must be an integer between 0 and 62. *column* must be an integer between 0 and 94.

pxl-Test(*row*,*column*)

Split Screen

In **Split** screen MODE, the maximum value of *row* is 30 in **Pxl-On(**, **Pxl-Off(**, **Pxl-Change(**, and **pxl-Test(**.

Storing and Recalling Graph Pictures

Press [2nd] [DRAW] ◀ to display the DRAW STO menu. You can store an image of the current display and superimpose that image onto a displayed graph at a later time from the Home screen or a program.

DRAW STO Menu

DRAW POINTS STO	
1: StorePic	Store the current picture
2: RecallPic	Recall a saved picture
3: StoreGDB	Store the current graph database
4: RecallGDB	Recall a saved graph database

Storing a Graph Picture

A picture includes drawn elements, plotted functions, axes, and tick marks. The picture does not include axis labels, lower and upper bound indicators, prompts, or cursor coordinates. Any parts of the display "hidden" by these are stored with the picture.

1. Press [2nd] [DRAW] ◀ (to display the DRAW STO menu) **1** (to select **StorePic**). **StorePic** is copied to the Home screen or program editor.
2. Press [VARS] **4** (to display the VARS PIC menu). Select **Pic1**, **Pic2**, **Pic3**, **Pic4**, **Pic5**, or **Pic6**.

   StorePic Pic*n*
3. Press [ENTER]. The current graph is displayed and the picture is stored.

Recalling a Graph Picture

1. Press [2nd] [DRAW] ◀ (to display the DRAW STO menu) **2** (to select **RecallPic**). **RecallPic** is copied to the Home screen or program editor.
2. Press [VARS] **4** (to display the VARS PIC menu). Select **Pic1**, **Pic2**, **Pic3**, **Pic4**, **Pic5**, or **Pic6**.

   RecallPic Pic*n*
3. Press [ENTER]. The current graph is displayed if necessary, and the picture is superimposed.

Note: Pictures are drawings. You cannot TRACE any curve on a picture.

Deleting a Graph Picture

Graph pictures are deleted from memory through the MEM menu (Chapter 15.)

Storing and Recalling

A graph data particular gr elements. Yo recall any of

Graph Databases

The elements

- Graphing
- WINDOW
- All functi selected.

Graph databa Stat Plot defi

Storing a Graph Database

1. Press [2nd] **3** (to selec Home scr
2. Press [VAR **GDB1, GD**
3. Press [ENTE

   StoreGDB

Recalling a Graph Database

Caution: Wh functions are Y= functions database.

1. Press [2nd] **4** (to selec Home scr
2. Press [VAR **GDB1, GD**

   RecallGDB
3. Press [ENTE current on changes g

Deleting a Graph Database

Graph databa MEM menu (C

Storing and Recalling Graph Databases

A graph database is the set of elements that define a particular graph. The graph can be recreated from these elements. You can store up to six graph databases and recall any of them to recreate a graph at a later time.

Graph Databases

The elements of a graph database are:

- Graphing MODE.
- WINDOW variables and WINDOW FORMAT.
- All functions in the Y= list, and whether they are selected.

Graph databases do not include any drawn items or any Stat Plot definitions.

Storing a Graph Database

1. Press 2nd [DRAW] ◀ (to display the DRAW STO menu) **3** (to select **StoreGDB**). **StoreGDB** is copied to the Home screen or program editor.
2. Press VARS **3** (to display the VARS GDB menu). Select **GDB1**, **GDB2**, **GDB3**, **GDB4**, **GDB5**, or **GDB6**.
3. Press ENTER. The current database is stored.

StoreGDB GDB*n*

Recalling a Graph Database

Caution: When you recall a graph database, all existing Y= functions are replaced. You may want to store the current Y= functions to another database before recalling a stored database.

1. Press 2nd [DRAW] ◀ (to display the DRAW STO menu) **4** (to select **RecallGDB**). **RecallGDB** is copied to the Home screen or program editor.
2. Press VARS **3** (to display the VARS GDB menu). Select **GDB1**, **GDB2**, **GDB3**, **GDB4**, **GDB5**, or **GDB6**.

RecallGDB GDB*n*

3. Press ENTER. The new graph database replaces the current one. The new graph is not plotted. (The TI-82 changes graphing MODE automatically, if necessary.)

Deleting a Graph Database

Graph databases are deleted from memory through the MEM menu (Chapter 15.)

Clearing a Drawing

All points, lines, and shading drawn on a graph with DRAW operations are temporary. They remain only until you execute a ClrDraw (clear drawing) instruction or a change prompts Smart Graph to replot the graph, at which time all drawn elements are erased.

When a Graph is Displayed

To clear drawings from the currently displayed graph, select **ClrDraw** from the DRAW DRAW menu (item 1). The current graph is plotted and displayed immediately with no drawn elements.

From the Home Screen or a Program

Begin on a blank line on the Home screen or in the program editor. Select **ClrDraw** from the DRAW DRAW menu (item 1). The instruction is copied to the cursor location.

When the instruction is executed, it clears all drawings from the current graph and displays the message Done. The next time you display the graph, all drawn points, lines, circles, and shaded areas will be gone.

Note: Before you clear drawings, you can store them with **StorePic** (page 8-14).

On the TI-82, y
(including a st
screen, Y= edit

Chapter Contents
Getting Started
Using Split Scre

hading drawn on a graph with
temporary. They remain only until
(clear drawing) instruction or a
Graph to replot the graph, at
ements are erased.

the currently displayed graph,
DRAW DRAW menu (item 1). The
and displayed immediately with no

the Home screen or in the
lrDraw from the DRAW DRAW
uction is copied to the cursor

executed, it clears all drawings
nd displays the message Done.
y the graph, all drawn points,
l areas will be gone.

drawings, you can store them with

Chapter 9: Split Screen

On the TI-82, you can simultaneously display a graph (including a stat plot) and an editor such as the Home screen, Y= editor, list editor, or table editor.

Chapter Contents

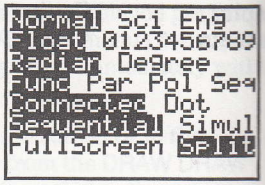
Getting Started: Polynomial Coefficients 9-2
Using Split Screen 9-3

Getting Started: Polynomial Coefficients

Getting Started is a fast-paced introduction. Read the chapter for details.

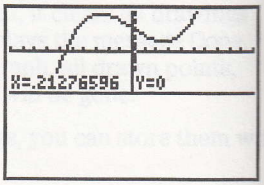
Use the split screen capability to explore the behavior of the graph of a polynomial as the coefficients change.

1. In **Func** MODE, press [Y=] to display the Y= screen. Press **.1** [X,T,Θ] [MATH] **3** (to select ^{3}) [−] **2** [X,T,Θ] [+] **6** [ENTER] to enter the polynomial $.1X^3-2X+6$.



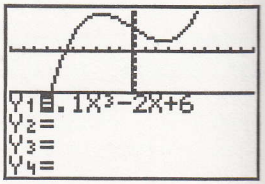
2. Press [MODE] to enter display the MODE screen. Press [▼] [▼] [▼] [▼] [▼] [▼] [▶] [ENTER] to set the screen to **Split**.

3. Press [ZOOM] **6** (to select **ZStandard**). The TI-82 split screen is displayed. The current graph is plotted in the standard viewing WINDOW (just compressed) and displayed on the top half of the display. The bottom half is blank.



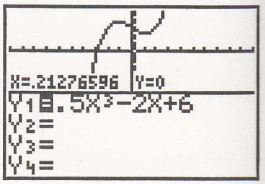
4. Press [▶] to activate the free-moving cursor.

5. Press [Y=]. The Y= editor displays on the bottom half of the display and the cursor moves to the Y= editor.



6. Press [▶] to move the cursor over the 1. Press **5**. The graph does not change.

7. Press [GRAPH] to plot the new graph. This also moves the cursor to the upper window. Press [▶] to see the free-moving cursor.

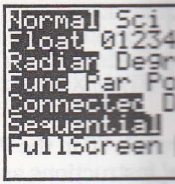


Using Split Screen

**Once you have s
until you change
replaced tempor
press a key in sp
automatically m
that key.**

Setting Screen MODE

To change the sc
vice versa, you m



Split Screen: Top

The top half disp

The cursor is pla
GRAPH, TRACE,

Split Screen: Bottom

The bottom half

- Home screen
- Y= editor (4 li
- Table (2 rows
- STAT list edit
- WINDOW (3 s

The cursor is pla
whenever a key
displays.

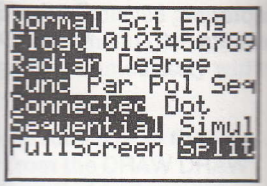
Exceptions

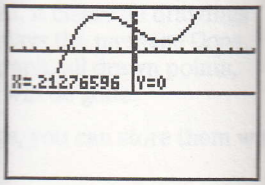
The split screen
screen display fo

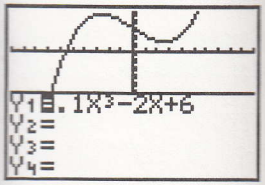
- Full-screen m
- MODE screen
- Matrix editor
- TABLE SETU
- Program edit
- Memory man

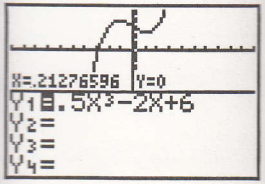
n. Read the chapter for details.

the behavior of the graph of a





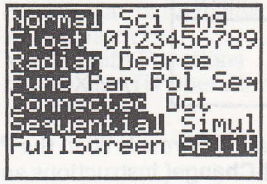




Once you have selected split screen, it remains in effect until you change it. A split-screen display may be replaced temporarily by a full-screen display. When you press a key in split-screen MODE, the cursor automatically moves to the correct half of the display for that key.

Setting Screen MODE

To change the screen MODE from **FullScreen** to **Split** or vice versa, you must use the MODE screen.



Split Screen: Top

The top half displays the graph screen (any MODE).

The cursor is placed in the upper half of the display by GRAPH, TRACE, a ZOOM operation, or a CALC operation.

Split Screen: Bottom

The bottom half displays an editor.

- Home screen (4 lines)
- Y= editor (4 lines)
- Table (2 rows)
- STAT list editor (2 rows)
- WINDOW (3 settings, can be scrolled)

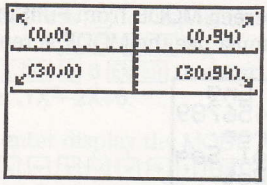
The cursor is placed in the bottom half of the display whenever a key is pressed that moves to one of these displays.

Exceptions

The split screen will be replaced temporarily by a full-screen display for:

- Full-screen menus
- MODE screen, WINDOW FORMAT screen
- Matrix editor
- TABLE SETUP, SET UP CALCS, STAT PLOTS
- Program editor
- Memory management

TI-82 Pixels



DRAW Pixels Instructions

The maximum value of *row* is 30 in the **PxI-On(**, **PxI-Off(**,and **PxI-Change(** instructions and the **pxl-Test(** function when MODE is **Split**.

PxI-On(*row*,*column*)

DRAW Text Instruction

The maximum value of *row* is 27 in the **Text(** instruction when MODE is **Split**.

Text(*row*,*column*,"*text*")

PRGM Output Instruction

The maximum value of *row* is 4 in the **Output(** instruction when MODE is **Split**.

Output(*row*,*column*,"*text*")

Setting Screen MODE from the Home Screen or a Program

To set screen MODE from a program, press MODE on a blank line in the program editor and select **FullScreen** or **Split**. The instruction is copied to the cursor location. The MODE is set when the instruction is encountered during execution and remains in effect after the program is done.

This chapter
The TI-82 can
depending on
or columns.

Chapter Contents

Getting Started
Defining a Mat
Viewing Matrix
Editing Matrix
About Matrices
Matrix Math Fu
MATRIX MATH

Chapter 10: Matrices

This chapter describes the matrix features of the TI-82. The TI-82 can store up to five matrices. A matrix, depending on available memory, may have up to 99 rows or columns.

Chapter Contents

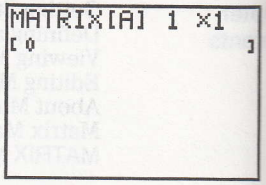
Getting Started: Systems of Linear Equations	10-2
Defining a Matrix	10-4
Viewing Matrix Elements	10-5
Editing Matrix Elements	10-6
About Matrices	10-8
Matrix Math Functions	10-10
MATRIX MATH Operations	10-12

Getting Started: Systems of Linear Equations

Getting Started is a fast-paced introduction. Read the chapter for details.

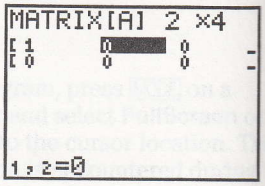
Find the solution of x + 2y + 3z = 3 and 2x + 3y + 4z = 3. On the TI-82, you can solve a system of linear equations by entering the coefficients as elements in a matrix and then using the matrix row operations to obtain the reduced row echelon form.

1. Press [MATRX]. Press [▶] [▶] to display the MATRX EDIT menu. Press **1** to select [A] to edit matrix [A]



2. Press **2** [ENTER] **4** [ENTER] to define a 2×4 matrix. The rectangular cursor indicates the current element. The ellipses points at the right indicate that one or more additional columns exist.

3. Press **1** [ENTER] to enter the first element. The rectangular cursor moves to the second column of the first row.



4. Press **2** [ENTER] **3** [ENTER] **3** [ENTER] to complete the top row.
5. Press **2** [ENTER] **3** [ENTER] **4** [ENTER] **3** [ENTER] to enter the bottom row.

6. Press [2nd] [QUIT] to return to the Home screen. Begin on a blank li
Press [MATRX] [▶] to display the MA
MATH menu. Press [▼] until the
bottom items on the menu are sh
then select ***row+(** (item A). ***row+**
copied to the Home screen.

7. Press [(-)] **2** [,]. Press [MATRX] **1** (to select [A] from the MATRX NAME
menu). Press [,] **1** [,] **2** [)] [ENTER].
multiplies row 1 by -2 and adds it
row 2. The resulting matrix is
displayed and stored in **Ans**. The
value of [A] is not changed.

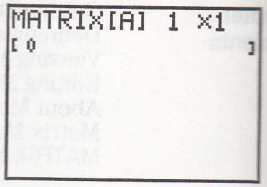
8. Press [MATRX] [▶] to display the MA
MATH menu. Select ***row(** (item 0)
and then press [(-)] **1** [,] [2nd] [Ans] [
2 [)] [ENTER]. This multiplies row 2
the matrix in **Ans** by -1. Again, the
resulting matrix is displayed and
stored in **Ans**.

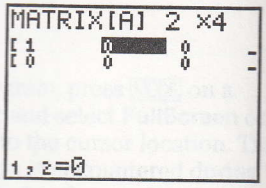
9. Press [MATRX] [▶]. Select ***row+(**
(item A). Press [(-)] **2** [,] [2nd] [Ans] [
[,] **1** [)] [ENTER]. This multiplies row
of the matrix in **Ans** by -2 and add
to row 1. The resulting reduced ro
echelon form of the matrix is
displayed and stored in **Ans**.

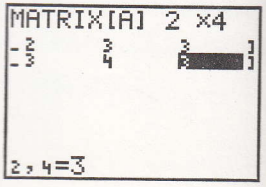
$$\begin{aligned} 1x - 1z &= -3 \\ 1y + 2z &= 3 \end{aligned} \quad \text{so} \quad \begin{aligned} x &= -3 + \\ y &= 3 - \end{aligned}$$

uction. Read the chapter for details.

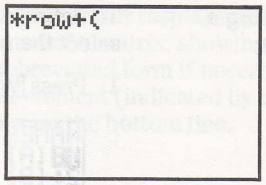
d 2x + 3y + 4z = 3. On the TI-82, tions by entering the coefficients g the matrix row operations to



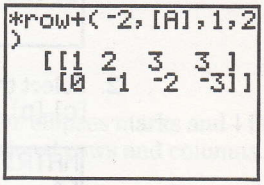




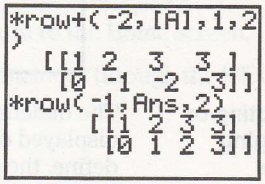
6. Press 2nd [QUIT] to return to the Home screen. Begin on a blank line. Press MATRX ▶ to display the MATRX MATH menu. Press ▼ until the bottom items on the menu are shown, then select ***row+(** (item A). ***row+(** is copied to the Home screen.



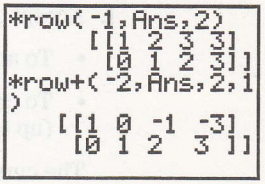
7. Press (-) **2** , . Press MATRX **1** (to select [**A**] from the MATRX NAMES menu). Press , **1** , **2**) ENTER. This multiplies row 1 by -2 and adds it to row 2. The resulting matrix is displayed and stored in **Ans**. The value of [**A**] is not changed.



8. Press MATRX ▶ to display the MATRX MATH menu. Select ***row(** (item 0) and then press (-) **1** , 2nd [Ans] , **2**) ENTER. This multiplies row 2 of the matrix in **Ans** by -1. Again, the resulting matrix is displayed and stored in **Ans**.



9. Press MATRX ▶. Select ***row+(** (item A). Press (-) **2** , 2nd [Ans] , **2** , **1**) ENTER. This multiplies row 2 of the matrix in **Ans** by -2 and adds it to row 1. The resulting reduced row-echelon form of the matrix is displayed and stored in **Ans**.



$$1x - 1z = -3 \quad \text{so} \quad x = -3 + z$$
$$1y + 2z = 3 \quad\quad\quad\quad y = 3 - 2z$$

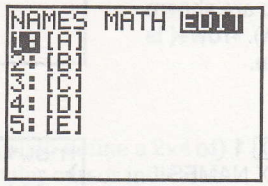
Defining a Matrix

A matrix is a two-dimensional array. You can display, enter, or edit a matrix in the matrix editor. The TI-82 has five matrix variables: [A], [B], [C], [D], or [E]. You can define a matrix directly in an expression.

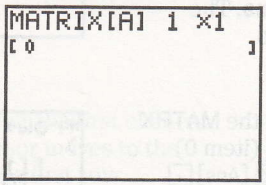
Selecting a Matrix

To define or display a matrix in the editor, you first must select the name of the matrix.

1. Press MATRX ▶ ▶ to display the MATRX EDIT menu.



2. Select the matrix you want to define (either [A], [B], [C], [D], or [E]). The MATRX EDIT screen appears.



Accepting or Changing Matrix Dimensions

The dimensions of the matrix (row × column) are displayed on the top line. When you select a matrix to define, the cursor is on the row dimension. You must accept or change the dimensions each time you enter or edit a matrix. A "new" matrix has dimension 1×1.

1. Accept or change the number of rows.
   - To accept the number, press ENTER.
   - To change the number, enter the number of rows (up to 99), and then press ENTER.

   The cursor moves to the number of columns.
2. Accept or change the number of columns as above.

The rectangular cursor moves to the first matrix element.

Viewing Matrix Elements

After the dimensi be viewed and va elements. In a "ne

Displaying Matrix Elements

The center portion seven rows and th values of the elem The full value of t rectangular cursor

An 8×4 matrix is s right column indic

Leaving the MATRX Edit Screen

To leave the MATR

- Select another
- Press 2nd [QUI

Deleting a Matrix

Matrices are delet (Chapter 15).

onal array. You can display, he matrix editor. The TI-82 has [B], [C], [D], or [E]. You can an expression.

rix in the editor, you first must rix.

splay the MATRX EDIT menu.

ant to define (either [A], [B], TRX EDIT screen appears.

rix (row × column) are When you select a matrix to row dimension. You must nsions each time you enter or rix has dimension 1×1.

mber of rows.

r, press [ENTER].

er, enter the number of rows press [ENTER].

e number of columns.

mber of columns as above.

ves to the first matrix element.

Viewing Matrix Elements

After the dimensions of the matrix are set, the matrix can be viewed and values can be entered into the matrix elements. In a "new" matrix, all values are zero.

Displaying Matrix Elements

The center portion of the matrix editor displays up to seven rows and three columns of a matrix, showing the values of the elements in abbreviated form if necessary. The full value of the current element (indicated by the rectangular cursor) is shown on the bottom line.

An 8×4 matrix is shown. The ellipses marks and ↓ in the right column indicate additional rows and columns.

Leaving the MATRX Edit Screen

To leave the MATRX edit screen:

- Select another screen by pressing the appropriate key.
- Press [2nd] [QUIT] to return to the Home screen.

Deleting a Matrix

Matrices are deleted from memory through the MEM menu (Chapter 15).

Editing Matrix Elements

The matrix editor has two "contexts," viewing and editing. The current context determines the result of a keypress.

Viewing a Matrix

In viewing context, you can move quickly from one matrix element to the next. The full value of the current element is displayed on the bottom line.

Viewing Context Keys

◀ or ▶	Moves the rectangular cursor within the current row.
▼ or ▲	Moves the rectangular cursor within the current column. On the top row, ▲ moves cursor to the column dimension. On the column dimension, moves cursor to the row dimension.
ENTER	Switches to editing context; activates the edit cursor on the bottom line.
CLEAR	Switches to editing context; clears the value on the bottom line.
Any entry character	Switches to editing context; clears the value on the bottom line; copies the character to the bottom line.
2nd [INS]	Nothing.
DEL	Nothing.

Editing a Matrix Element

In editing context
line, and you can
element.

1. Use the cursor
the matrix ele
2. Switch to editi
an entry key.
3. Change the val
an expression
editing context
CLEAR, followe
rectangular cu
4. Press ENTER, ▲

Editing Context Keys

◀ or ▶
▼ or ▲
ENTER
CLEAR
Any entry character
2nd [INS]
DEL

Editing a Matrix Element

In editing context, an edit cursor is active on the bottom line, and you can change the value of the current matrix element.

1. Use the cursor-movement keys to move the cursor to the matrix element you want to change.
2. Switch to editing context by pressing [ENTER], [CLEAR], or an entry key.
3. Change the value of the matrix element. You may enter an expression (which is evaluated when you leave the editing context) for the value. **Note:** You can press [CLEAR], followed by [ENTER] to restore the value at the rectangular cursor if you make a mistake.
4. Press [ENTER], [▲], or [▼] to move to another element.

Editing Context Keys

[◄] or [►]	Moves the edit cursor within the value.
[▼] or [▲]	Stores the value on the bottom line to the matrix element; switches to viewing context and moves the rectangular cursor within the column.
[ENTER]	Stores the value on the bottom line to the matrix element; switches to viewing context. Rectangular cursor moves to the next element.
[CLEAR]	Clears the value on the bottom line.
Any entry character	Copies the character to the location of the edit cursor on the bottom line.
[2nd] [INS]	Activates insert cursor.
[DEL]	Deletes the character under the edit cursor on the bottom line.

About Matrices

On the Home screen or in a program, you can use, enter, store, and display matrices.

Using a Matrix in an Expression

To use a matrix in an expression, you may:

- Copy the name from the MATRIX NAMES menu.
- Recall the contents of the matrix into the expression with 2nd [RCL] (Chapter 1).
- Enter the matrix directly (see below).

Entering a Matrix in an Expression

You can enter, edit, and store a matrix in the MATRIX editor. You also can enter a matrix directly in an expression.

1. Press 2nd [[] to indicate the beginning of the matrix.
2. Press 2nd [[] to indicate the beginning of a row.
3. Enter a value (which can be an expression) for each element in the row, separated by commas.
4. Press 2nd [] to indicate the end of a row.
5. Repeat steps 2 through 4 to enter all of the rows.
6. Press 2nd [] to indicate the end of the matrix.

Note: The closing]] is not necessary at the end of an expression or preceding →.

[[*element*$_{1,1}$, ... ,*element*$_{1,n}$] ... [*element*$_{m,1}$, ... ,*element*$_{m,n}$]]

The expression is evaluated when the entry is executed. Commas are required on entry to separate elements, but are not displayed on output.

```
2*[[1,2,3][4,5,6
]]
      [[2 4  6 ]
       [8 10 12]]
```

Displaying a Matrix

To display the conte
copy the name from
ENTER.

```
[A]
          [[9 8 7
           [6 5 4
           [3 2 1
```

If all of a matrix ans
indicated by ellipsis
or ↓ in the right colu
rest of the matrix.

```
...0000 .1429
...0000 0.0000
...0000 0.0000
...0000 0.0000
...0000 0.0000
...0000 0.0000
...0000 0.0000
```

Copying One Matrix to Another

To copy a matrix, st
names on the MATR

```
[A]→[B]
```

Accessing a Matrix Element

You can store a valu
matrix element on th
The element must be
dimensions.

matrix(*row*,*column*)

```
0→[A](2,3):[A]
          [[9 8 7
           [6 5 0
           [3 2 1
```

r in a program, you can use, enter,
rices.

xpression, you may:

the MATRIX NAMES menu.

of the matrix into the expression
ter 1).

ctly (see below).

store a matrix in the MATRIX
er a matrix directly in an

ate the beginning of the matrix.

ate the beginning of a row.

can be an expression) for each
eparated by commas.

ate the end of a row.

gh 4 to enter all of the rows.

ate the end of the matrix.

s not necessary at the end of an
ing →.

$_{m,n}$] ... [$element_{m,1}$, ... ,$element_{m,n}$]]

ted when the entry is executed.
entry to separate elements, but are

Displaying a Matrix

To display the contents of a matrix on the Home screen, copy the name from the MATRX NAMES menu and press [ENTER].

```
[A]
        [[9 8 7]
         [6 5 4]
         [3 2 1]]
```

If all of a matrix answer does not fit in the display, as indicated by ellipsis marks in the left or right column or ↑ or ↓ in the right column, use [▶], [◀], [▼], and [▲] to display the rest of the matrix.

```
...0000 .1429  0↑
...0000 0.0000 0…
...0000 0.0000 0…
...0000 0.0000 0…
...0000 0.0000 0…
...0000 0.0000 0…
...0000 0.0000 0↓
```

Copying One Matrix to Another

To copy a matrix, store it to another matrix. (Access the names on the MATRX NAMES menu.)

```
[A]→[B]
```

Accessing a Matrix Element

You can store a value to (or recall a value from) a specific matrix element on the Home screen or from a program. The element must be within the currently defined matrix dimensions.

matrix(*row*,*column***)**

```
0→[A](2,3):[A]
        [[9 8 7]
         [6 5 0]
         [3 2 1]]
```

Matrix Math Functions

You can use many of the math functions on the keyboard, MATH MATH menu, and the MATH NUM menu with matrices. However, the dimensions must be appropriate.

+ (Add)
– (Subtract)

To add ([+]) or subtract ([–]) matrices, the dimensions must be the same. The answer is a matrix in which the elements are the sum or difference of the individual elements.

matrixA+*matrixB*
matrixA–*matrixB*

*** (Multiply)**

To multiply ([×]) two matrices together, the column dimension of *matrixA* must match the row dimension of *matrixB*.

*matrixA***matrixB*

Multiplying a *matrix* by a *value* or a *value* by a *matrix* returns a matrix in which each element of *matrix* is multiplied by *value*.

*matrix***value*
*value***matrix*

- (Negate)

Negating a matrix ([(-)]) returns a matrix in which the sign of every element is changed (reversed).

-*matrix*

abs

abs (absolute value, [2nd] [ABS]) returns a matrix containing the absolute value of each element of *matrix*.

abs *matrix*

round((MATH NUM menu) returns a matrix. It rounds every element in *matrix* to *#decimals*. If *#decimals* is omitted, the elements are rounded to 10 digits.

round(*matrix*,*#decimals***)**
round(*matrix***)**

Use the **-1** function ([x⁻¹]) to invert a matrix (**^-1** is not valid). *matrix* must be square. The determinant cannot equal zero.

matrix^{-1}

To raise a matrix to a power, *matrix* must be square. You may use **²**, **³**, or **^***n* (*n* between **0** and **255**).

matrix^2
matrix^3
matrix^*power*

To compare two matrices using the relational operations **=** and ≠, they must have the same dimensions. **=** and ≠ compare *matrixA* and *matrixB* on an element-by-element basis. The other relational operations are not valid with matrices.

matrixA=*matrixB* returns **1** if every comparison is true; it returns **0** if any comparison is false.

matrixA≠*matrixB* returns **1** if at least one comparison is false.

iPart, **fPart**, and **int** (MATH NUM menu) return a matrix containing the integer part, fractional part, or greatest integer of each element of *matrix*.

iPart *matrix*
fPart *matrix*
int *matrix*

any of the math functions on the
TH MATH menu, and the MATH NUM menu.
However, the dimensions must be

subtract (−) matrices, the dimensions must
e answer is a matrix in which the elements
difference of the individual elements.

xB
xB

two matrices together, the column
$trixA$ must match the row dimension of

xB

$trix$ by a *value* or a *value* by a *matrix*
in which each element of *matrix* is
ue.

(−) returns a matrix in which the sign
s changed (reversed).

e, 2nd [ABS]) returns a matrix containing
of each element of *matrix*.

round(

round((MATH NUM menu) returns a matrix. It rounds every element in *matrix* to *#decimals*. If *#decimals* is omitted, the elements are rounded to 10 digits.

round(*matrix*,*#decimals*)
round(*matrix*)

(Inverse)

Use the $^{-1}$ function (x^{-1}) to invert a matrix (**^-1** is not valid). *matrix* must be square. The determinant cannot equal zero.

matrix^{-1}

Powers

To raise a matrix to a power, *matrix* must be square. You may use ^{2}, ^{3}, or **^***n* (*n* between **0** and **255**).

matrix^2
matrix^3
*matrix***^***power*

Relational Operations

To compare two matrices using the relational operations = and ≠, they must have the same dimensions. = and ≠ compare *matrixA* and *matrixB* on an element-by-element basis. The other relational operations are not valid with matrices.

matrixA=*matrixB* returns **1** if every comparison is true; it returns **0** if any comparison is false.

matrixA≠*matrixB* returns **1** if at least one comparison is false.

iPart
fPart
int

iPart, **fPart**, and **int** (MATH NUM menu) return a matrix containing the integer part, fractional part, or greatest integer of each element of *matrix*.

iPart *matrix*
fPart *matrix*
int *matrix*

MATRX MATH Operations

Pressing [MATRX] ▶ accesses the matrix math operations on the MATRX MATH menu.

MATRX MATH Menu

```
NAMES  MATH  EDIT
1:det
2:T
3:dim
4:Fill(
5:identity
6:randM(
7:augment(
8:rowSwap(
9:row+(
0:*row(
A:*row+(
```

1:det	Calculates the determinant
2:T	Transposes the matrix
3:dim	Returns the matrix dimension
4:Fill(	Fills all elements with a constant
5:identity	Returns the identity matrix
6:randM(	Returns a random matrix
7:augment(	Augments two matrices
8:rowSwap(	Swaps two rows of a matrix
9:row+(	Adds two rows, stores in second row
0:*row(	Multiplies row by a number
A:*row+(	Multiplies row, adds to second row

det

det (determinant) returns the determinant (a real number) of a square *matrix*.

det *matrix*

T (Transpose)

T (transpose) returns a matrix in which each element(row,column) is swapped with the corresponding element(column,row) of *matrix*.

*matrix*T

Accessing Matrix Dimensions with dim

dim (dimension) returns a list containing the dimensions ({*rows columns*}) of *matrix*.

dim *matrix*

Note: dim *matrix*→L*n*:L*n*(1) returns the number of rows. **dim** *matrix*→L*n*:L*n*(2) returns the number of columns.

```
dim [[2,7,1][-8,
3,1]]
                {2 3}
dim [[2,7,1][-8,
3,1]]→L1:L1(1)
                  2
```

Creating a Matrix with dim

dim (MATRIX MAT
new *matrixname*
elements equal to

{*rows*,*columns*}→d

```
{2,2→dim [A]
                {
[A]
                [[0
                 [0
```

Redimensioning a Matrix with dim

dim is used with [ST
matrixname to di
in the old *matrix*
are not changed. A
are zeros.

{*rows*,*columns*}→d

Fill(

Fill((MATRIX MAT
in *matrixname*.

Fill(*value*,*matrix*

identity

identity (MATRIX M
of *dimension* rows

identity *dimensio*

randM(

randM((create ran
returns a *rows*×*col*
integers (-9 to 9). T
function.

randM(*rows*,*colum*

```
0→rand:randM
)-1▶Frac
     [[1/7  1
      [-1/7 0
```

ions

TRIX ▶ accesses the matrix math operations
RX MATH menu.

EDIT
Calculates the determinant
Transposes the matrix
Returns the matrix dimension
Fills all elements with a constant
Returns the identity matrix
Returns a random matrix
Augments two matrices
Swaps two rows of a matrix
Adds two rows, stores in second row
Multiplies row by a number
Multiplies row, adds to second row

nt) returns the determinant (a real number)
trix.

turns a matrix in which each
lumn) is swapped with the corresponding
,row) of *matrix*.

returns a list containing the dimensions
}) of *matrix*.

x→L*n*:L*n*(1) returns the number of rows.
L*n*(2) returns the number of columns.

```
][-8,
{2 3}
[[-8,
(1)
    2
```

Creating a Matrix with dim

dim (MATRIX MATH item 3) is used with STO▶ to create new *matrixname* of dimensions *rows* × *columns* with all elements equal to zero.

{*rows*,*columns*}→**dim** *matrixname*

```
{2,2}→dim [A]
                {2 2}
[A]
             [[0 0]
              [0 0]]
```

Redimensioning a Matrix with dim

dim is used with STO▶ to redimension existing *matrixname* to dimensions *rows* × *columns*. The elements in the old *matrixname* that are within the new dimensions are not changed. Any additional elements that are created are zeros.

{*rows*,*columns*}→**dim** *matrixname*

Fill(

Fill((MATRIX MATH item 4) stores *value* to every element in *matrixname*.

Fill(*value*,*matrixname*)

identity

identity (MATRIX MATH item 5) returns the identity matrix of *dimension* rows × *dimension* columns.

identity *dimension*

randM(

randM((create random matrix, MATRIX MATH item 6) returns a *rows*×*columns* matrix of random one-digit integers (-9 to 9). The values are controlled by the **rand** function.

randM(*rows*,*columns*)

```
0→rand:randM(2,2
)-1▶Frac
     [[1/7  1/8]
      [-1/7 0  ]]
```

augment(

augment((MATRIX MATH item 7) concatenates *matrixA* and *matrixB*. The number of rows in *matrixA* must equal the number of rows in *matrixB*.

augment(*matrixA*,*matrixB***)**

```
[[1,2][3,4]]→[A]
:[[5,6][7,8]]→[B
]:augment([A],[B
])
      [[1 2 5 6]
       [3 4 7 8]]
```

Row Operations

The row operations, which can be used in an expression, do not change *matrix* in memory. All row numbers and values can be entered as expressions.

rowSwap(

rowSwap((MATRIX MATH item 8) returns a matrix. It swaps *rowA* and *rowB* of *matrix*.

rowSwap(*matrix*,*rowA*,*rowB***)**

row+(

row+((row addition, MATRIX MATH item 9) returns a matrix. It adds *rowA* and *rowB* of *matrix* and stores the answer in *rowB*.

row+(*matrix*,*rowA*,*rowB***)**

***row(**

***row(** (row multiplication, MATRIX MATH item 0) returns a matrix. It multiplies *row* of *matrix* by *value* and stores the answer in *row*.

row(value*,*matrix*,*row***)**

***row+(**

***row+(** (multiply and add row, MATRIX MATH item A) returns a matrix. It multiplies *rowA* of *matrix* by *value*, adds it to *rowB*, and stores the answer in *rowB*.

row+(value*,*matrix*,*rowA*,*rowB***)**

```
[[1,2][3,4]]→[B]
            [[1 2]
             [3 4]]
*row+(3,[B],1,2)

          [[1 2 ]
           [6 10]]
```


This chapter describe
The TI-82 can store u
available memory, ma

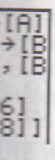
Chapter Contents

Getting Started: Gener
About Lists . . . . . .
LIST OPS Operations
LIST MATH Operations

(Continued)

MATH item 7) concatenates *matrixA*
umber of rows in *matrixA* must equal
in *matrixB*.

matrixB)



which can be used in an expression.
ix in memory. All row numbers and
ed as expressions.

MATH item 8) returns a matrix. It
B of *matrix*.

wA,rowB)

MATRIX MATH item 9) returns a
and *rowB* of *matrix* and stores the

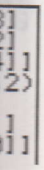
rowB)

ation, MATRIX MATH item 0) returns a
row of *matrix* by *value* and stores the

row)

add row, MATRIX MATH item A)
ultiplies *rowA* of *matrix* by *value*,
stores the answer in *rowB*.

rowA,rowB)



Chapter 11: Lists

This chapter describes the list features of the TI-82. The TI-82 can store up to six lists. A list, depending on available memory, may have up to 99 elements.

Chapter Contents

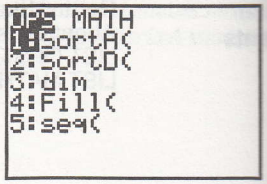
Getting Started: Generating a Sequence 11-2
About Lists 11-3
LIST OPS Operations 11-6
LIST MATH Operations 11-9

Getting Started: Generating a Sequence

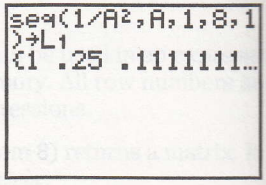
Getting Started is a fast-paced introduction. Read the chapter for details.

Calculate the first eight terms of the sequence $1/N^2$ and display in fractional form.

1. Begin on a blank line on the Home screen. Press 2nd [LIST] to display the LIST OPS menu.

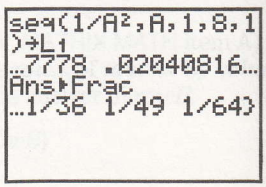


2. Press **5** to select **seq(**. The function name is copied to the cursor location on the Home screen.
3. Press **1** ÷ ALPHA **A** x^2 , ALPHA **A** , **1** , **8** , **1**) STO▸ 2nd [L1]. Press ENTER to generate the list and store it in **L1**. The list is displayed on the Home screen.



4. Use ▸ to scroll the list to see all of the elements.
5. Press MATH **1** (to select ▸**Frac**). On the Home screen, **Ans** is typed automatically, followed by ▸**Frac**.

6. Press ENTER to show the sequence in fractional form. Use ▸ to scroll the list to see all of the elements.



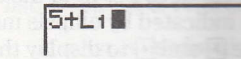
About Lists

**The TI-82 has six list
L5, and L6. On the Ho
use, enter, store, and
the keyboard.**

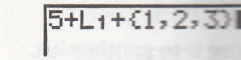
Using a List in an Expression

To use a list in an exp

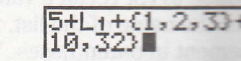
- Use the name of th



- Enter the list direc

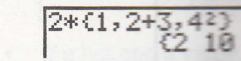


- Press 2nd [RCL], e
press ENTER to rec
expression at the



Entering a List in an Expression

1. Press 2nd [{] to ind
2. Enter a value (whi
element in the list,
3. Press 2nd [}] to ind

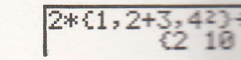


The expression is eval
Commas are required
are not displayed on
at the end of an expre

Saving a List in Memory

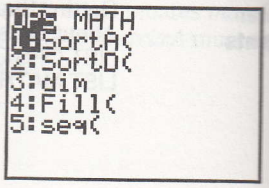
You can save a list in

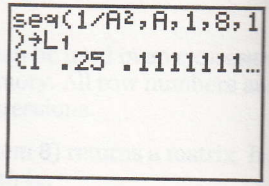
- Enter the list in the
- Enter the list on a
a program (see abo
name of the list (L

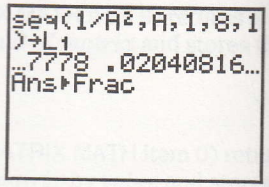


troduction. Read the chapter for details.

the sequence $1/N^2$ and display in







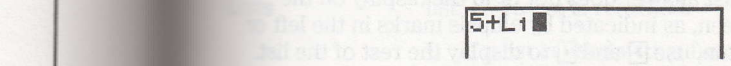
About Lists

The TI-82 has six list variables in memory: L1, L2, L3, L4, L5, and L6. On the Home screen or in a program, you can use, enter, store, and display lists. The list names are on the keyboard.

Using a List in an Expression

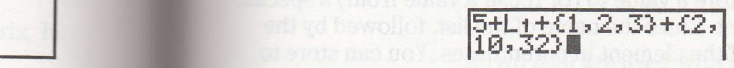
To use a list in an expression, you may:

- Use the name of the list (L1, L2, L3, L4, L5, or L6).



- Enter the list directly (see below).

- Press [2nd] [RCL], enter the name of the list, and then press [ENTER] to recall the contents of the list into the expression at the cursor location.



Entering a List in an Expression

1. Press [2nd] [{] to indicate the beginning of the list.
2. Enter a value (which can be an expression) for each element in the list, separated by commas.
3. Press [2nd] [}] to indicate the end of the list.

The expression is evaluated when the entry is executed. Commas are required on entry to separate elements, but are not displayed on output. The closing } is not necessary at the end of an expression or preceding →.

Saving a List in Memory

You can save a list in memory in two ways:

- Enter the list in the STAT list editor (Chapter 12).
- Enter the list on a blank line on the Home screen or in a program (see above), press [STO▸], and then enter the name of the list (L1, L2, L3, L4, L5, or L6).

Displaying a List

To display the contents of a list on the Home screen, enter the name of the list and press ENTER.

If all of a list answer does not fit in the display on the Home screen, as indicated by ellipsis marks in the left or right column, use ▶ and ◀ to display the rest of the list.

```
L6
{2 10 -1.088042...
```

Copying One List to Another

To copy a list, store it to another list.

```
L6→L5
{2 10 -1.088042...
```

Accessing a List Element

You can store a value to (or recall a value from) a specific list element. Enter the name of the list, followed by the number of the element in parentheses. You can store to any element within the currently defined list dimensions or one beyond.

listname(*element*)

```
{1,2,3}→L3
              {1 2 3}
4→L3(4)
                    4
L3
          {1 2 3 4}
```

Lists in Graphing

In graphing, lists are used to graph a family of curves (Chapter 3).

Notes about Using Math Functions with Lists

A list can be used functions. (Other valid.) The functio list, and a list is re

- If a list is used valid for every (In graphing, a √{1,0,-1}, is si

```
√{1,0,-1}
```

```
Y1■√{1,0,
Y2=
```

- If two lists are length of the li list in which e the function u lists.

```
{1,2,3}+{4
```

- If a list and a v function, the v

```
{1,2,3}+4
```

ontents of a list on the Home screen, enter
list and press [ENTER].

swer does not fit in the display on the
s indicated by ellipsis marks in the left or
se ▶ and ◀ to display the rest of the list.

```
88042...
```

tore it to another list.

```
88042...
```

value to (or recall a value from) a specific
er the name of the list, followed by the
lement in parentheses. You can store to
hin the currently defined list dimensions or

t)

```
 2 3}
   4
3 4}
```

are used to graph a family of curves

Notes about Using Math Functions with Lists

A list can be used to input several values for certain functions. (Other chapters and Appendix A state if a list is valid.) The function is evaluated for each element in the list, and a list is returned.

- If a list is used with a function, the function must be valid for every element in the list, except in graphing. (In graphing, an invalid element in a list, such as **-1** in **√{1,0,-1}**, is simply ignored.)

```
√{1,0,-1}
```

◀ This returns an error.

```
Y1■X√{1,0,-1}
Y2=
```

◀ This graphs **X*√1** and **X*√0**, but skips **X*√-1**.

- If two lists are used with a two-argument function, the length of the lists must be the same. The answer is a list in which each element is calculated by evaluating the function using the corresponding elements in the lists.

```
{1,2,3}+{4,5,6}
              {5 7 9}
```

- If a list and a value are used with a two-argument function, the value is used with each element in the list.

```
{1,2,3}+4
          {5 6 7}
```

LIST OPS Operations

Pressing 2nd [LIST] accesses the list operations on the LIST OPS menu.

LIST OPS Menu

```
OPS  MATH
1:SortA(      Sorts lists in ascending order
2:SortD(      Sorts lists in descending order
3:dim         Accesses the list dimension
4:Fill(       Fills all elements with a constant
5:seq(        Creates a sequence
```

Note: dim and **Fill(** are the same as **dim** and **Fill(** on the MATRX MATH menu. **SortA(** and **SortD(** are the same as **SortA(** and **SortD(** on the STAT EDIT menu.

SortA(
SortD(

SortA((sort ascending) and **SortD(** (sort descending) have two uses.

- With one *listname*, they sort the elements of an existing list and update the list in memory.
- With two to six *listnames*, they sort the first list and then sort the remaining lists as dependent lists, element-by-element, and update the lists in memory. All lists must be the same length.

SortA(*listname***)**
SortA(*listnameI*,*listnameD*,*listnameD*, . . .**)**

```
{5,4,3}→L3:{1,2,
3}→L4:SortA(L3,L
4):L3
                {3 4 5}
L4
                {3 2 1}
```

Accessing List Dimensions with dim

dim (dimension) retu of *list*.

dim *list*

```
dim {1,3,5,7}
```

Creating a List with dim

dim is used with STO▸ dimension *length*. The

length→**dim** *listname*

```
3→dim L2
L2
                {0 0
```

Redimensioning a List with dim

dim is used with STO▸ dimension *length*.

- The elements in th new dimension ar
- Any additional ele

length→**dim** *listname*

```
{1,3,5,7}→L4:5
im L4:L4
          {1 3 5 7
3→dim L4:L4
          {1 3
```

] accesses the list operations on the

Sorts lists in ascending order
Sorts lists in descending order
Accesses the list dimension
Fills all elements with a constant
Creates a sequence

are the same as **dim** and **Fill(** on the
. **SortA(** and **SortD(** are the same as
n the STAT EDIT menu.

ing) and **SortD(** (sort descending) have

ie, they sort the elements of an
update the list in memory.

istnames, they sort the first list and
aining lists as dependent lists,
ent, and update the lists in memory.
he same length.

nameD,*listnameD*, . . .)

```
2,
,L
5}
1}
```

Accessing List Dimensions with dim

dim (dimension) returns the length (number of elements) of *list*.

dim *list*

```
dim {1,3,5,7}
                4
```

Creating a List with dim

dim is used with STO▸ to create new *listname* with dimension *length*. The elements are zeros.

length→**dim** *listname*

```
3→dim L2
                3
L2
            {0 0 0}
```

Redimensioning a List with dim

dim is used with STO▸ to redimension existing *listname* to dimension *length*.

- The elements in the old *listname* that are within the new dimension are not changed.
- Any additional elements that are created are zeros.

length→**dim** *listname*

```
{1,3,5,7}→L4:5→d
im L4:L4
        {1 3 5 7 0}
3→dim L4:L4
          {1 3 5}
```

Fill(

Fill((LIST OPS item 4) stores *value* to each element in *listname*.

Fill(*value*,*listname*)

```
L3
              {3 4 5}
Fill(8,L3)
                 Done
L3
              {8 8 8}
```

seq(

seq((sequence, LIST OPS item 5) returns a list in which each element is the value of *expression*, evaluated at *increments* for *variable* from *begin* to *end*.

seq(*expression*,*variable*,*begin*,*end*,*increment*)

```
seq(A²,A,1,11,3)
    {1 16 49 100}
```

variable need not be defined in memory. *increment* can be negative. **seq(** is not valid in the *expression*.

Un or **Vn** is not valid in *expression*. To generate a sequence from **Un** or **Vn**, use **Un(***nstart*,*nstop*,*nstep***)**.

Pressing 2nd [LIST] ▶ a
on the LIST MATH men

LIST MATH
Menu

```
OPS  MATH
1:min(          Retu
2:max(          Retu
3:mean(         Retu
4:median(       Retu
5:sum           Retu
6:prod          Retu
```

Note: min(and **max(** a
the MATH NUM menu.

min(
max(

min((minimum) and **m**
or largest element of *lis*
returns a list of the larg
and *listB*.

min(*list***)** or **max(***list***)**
min(*listA*,*listB***)** or **max**

```
min({1,2,3},{3,2
,1})
              {1 2 1}
max({1,2,3},{3,2
,1})
              {3 2 3}
```

mean(
median(

mean(returns the mea
median value of *list*.

mean(*list***)** or **median(***li*

If a second list is given,
the elements in *list*.

mean(*list*,*frequency***)** o

```
mean({1,2,3},{3
2,1})
     1.666666666
median({1,2,3},
3,2,1})
                1.
```

ed)

) stores *value* to each element in

5}
ne
3}

OPS item 5) returns a list in which
lue of *expression*, evaluated at
le from *begin* to *end*.

ble,begin,end,increment)

5}
0}

efined in memory. *increment* can be
alid in the *expression*.

expression.To generate a sequence
(*nstart,nstop,nstep*).

LIST MATH Operations

Pressing 2nd [LIST] ▶ accesses the list math operations on the LIST MATH menu.

LIST MATH menu

OPS MATH	
1: min(	Returns minimum element of a list
2: max(	Returns maximum element of a list
3: mean(	Returns mean of a list
4: median(	Returns median of a list
5: sum	Returns sum of all elements in list
6: prod	Returns product of all elements in list

Note: min(and **max(** are the same as **min(** and **max(** on the MATH NUM menu.

min(
max(

min((minimum) and **max(** (maximum) return the smallest or largest element of *list*. If two lists are compared, it returns a list of the larger of each pair of elements in *listA* and *listB*.

min(*list***)** or **max(***list***)**
min(*listA,listB***)** or **max(***listA,listB***)**

```
min({1,2,3},{3,2
,1})
                {1 2 1}
max({1,2,3},{3,2
,1})
                {3 2 3}
```

mean(
median(

mean(returns the mean value of *list*. **median(** returns the median value of *list*.

mean(*list***)** or **median(***list***)**

If a second list is given, it is interpreted as the *frequency* of the elements in *list*.

mean(*list,frequency***)** or **median(***list,frequency***)**

```
mean({1,2,3},{3,
2,1})
      1.666666667
median({1,2,3},{
3,2,1})
                1.5
```

sum

sum (summation, LIST MATH item 5) returns the sum of the elements in *list*.

sum *list*

```
sum {5,2,3}
                    10
```

prod

prod (LIST MATH item 6) turns product of the elements of *list*.

prod *list*

```
prod {5,2,3}
                    30
```

Sums and Products of Numeric Sequences

You can combine **sum** or **prod** with **seq(** to obtain:

$$\sum_{x=lower}^{upper} expression(x) \qquad \prod_{x=lower}^{upper} expression(x)$$

To evaluate $\Sigma\, 2^{(N-1)}$ from N=1 to 4:

```
sum seq(2^(N-1),
N,1,4,1)
                    15
```


This chapter descri data on the TI-82. T calculating statistic plotting data.

Chapter Contents

Getting Started: Bui
Setting Up a Statisti
Viewing List Elemer
Editing List Elemen
STAT EDIT Menu
Statistical Analysis
Statistical Variables
Types of Statistical
Statistical Analysis i
Statistical Plotting
Statistical Plotting i

nued)

T MATH item 5) returns the sum of

10

n 6) turns product of the elements of

30

or **prod** with **seq(** to obtain:

$$\prod_{x=lower}^{upper} expression(x)$$

m N=1 to 4:

5

Chapter 12: Statistics

This chapter describes the tools for analyzing statistical data on the TI-82. These include entering lists of data, calculating statistical results, fitting data to a model, and plotting data.

Chapter Contents

Getting Started: Building Height and City Size	12-2
Setting Up a Statistical Analysis	12-9
Viewing List Elements	12-10
Editing List Elements	12-11
STAT EDIT Menu	12-12
Statistical Analysis	12-13
Statistical Variables	12-14
Types of Statistical Analysis	12-15
Statistical Analysis in a Program	12-17
Statistical Plotting	12-18
Statistical Plotting in a Program	12-22

Getting Started: Building Height and City Size

Getting Started is a fast-paced introduction. Read the chapter for details.

Determine a linear equation to fit the data below. Enter and plot the data and determine the best line, then predict how many buildings of more than 12 stories you would expect to find in a city of 300,000 people. Begin by entering the data in the STAT list editor and sorting it.

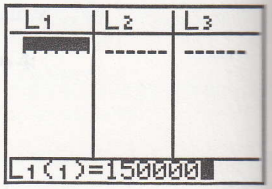
Population	Buildings>12 stories
150,000	4
500,000	31
800,000	42
250,000	9
500,000	20
750,000	55
950,000	73

1. To clear any existing lists, press [STAT] **4** (to copy **ClrList** to the Home screen) and then press [2nd] [L1] [,] [2nd] [L2] [,] [2nd] [L3] [,] [2nd] [L4] [,] [2nd] [L5] [,] [2nd] [L6] [ENTER].

2. Press [STAT] to display the STAT EDIT menu.

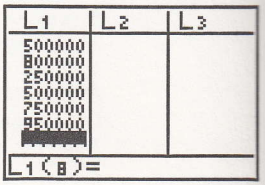
3. Press **1** (to select **Edit...**). The STAT list editor is displayed.

   Press **150000**. As you type, the value is displayed on the bottom line.



4. Press [ENTER]. The value is shown in the first element of **L1** and the cursor moves to the second element in the same list.

   Press **500000** [ENTER] **800000** [ENTER] **250000** [ENTER] **500000** [ENTER] **750000** [ENTER] **950000** [ENTER] to enter the remaining elements of **L1**.



5. Press [▶] to move to the first element list **L2**.

6. Press **4** [ENTER] **31** [ENTER] **42** [ENTER] **9** [EN] **20** [ENTER] **55** [ENTER] **73** [ENTER] to enter elements of **L2**.

7. You can sort the data by size of city. Press [STAT] **2** (to select **SortA(**, which copied to the Home screen) [2nd] [L1] select the independent list) [,] [2nd] [L (to select the dependent list) [)] [ENTE

8. The lists have been updated in memo Press [STAT] **1** to use the STAT list edi to display the lists.

oduction. Read the chapter for details.

e data below. Enter and plot the data. redict how many buildings of more o find in a city of 300,000 people. TAT list editor and sorting it.

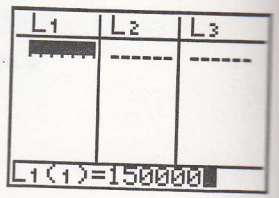
ies

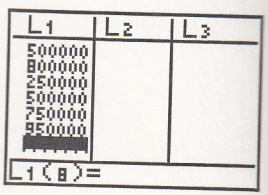
T 4
) and

ist

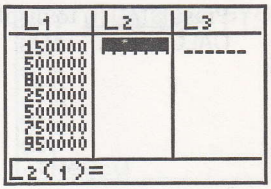
is

e
res

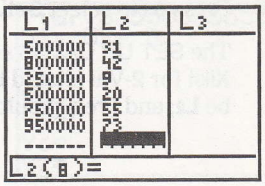




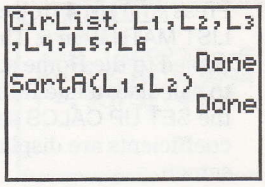
5. Press ▶ to move to the first element of list **L2**.



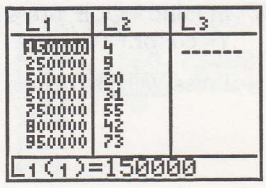
6. Press **4** ENTER **31** ENTER **42** ENTER **9** ENTER **20** ENTER **55** ENTER **73** ENTER to enter the elements of **L2**.



7. You can sort the data by size of city. Press STAT **2** (to select **SortA(**, which is copied to the Home screen) 2nd [L1] (to select the independent list) , 2nd [L2] (to select the dependent list)) ENTER.

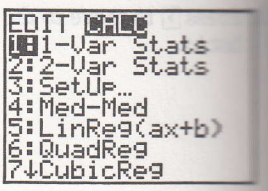


8. The lists have been updated in memory. Press STAT **1** to use the STAT list editor to display the lists.



After entering and sorting the data, set up the statistical calculations, then perform the calculations, storing the equations in the Y= list.

9. Press [STAT] [▶] to display the STAT CALC menu.

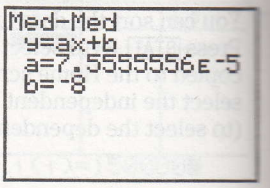


10. Press **3** (to select **SetUp...**).

    The SET UP CALCS screen appears. Xlist for 2-Var should be **L1**; Ylist should be **L2**; and Freq should be **1**.

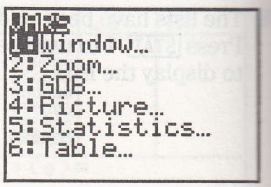
SET UP CALCS
1-Var
Xlist: L1 L2 L3 L4 L5 L6
Freq: 1 L1 L2 L3 L4 L5 L6
2-Var
Xlist: L1 L2 L3 L4 L5 L6
Ylist: L1 L2 L3 L4 L5 L6
Freq: 1 L1 L2 L3 L4 L5 L6

11. Press [STAT] [▶] **4** (to select **Med-Med**), LIST MATH item 5. The instruction is copied to the Home screen. Press [ENTER] to calculate a line fitting the data using the SET UP CALCS settings. The model coefficients are displayed on the Home screen.



12. In **Func** MODE, press [Y=] to display the Y= editor.

    Press [VARS] to display the VARS screen.



13. Press **5** (to select **Statistics...**) and to display the VARS EQ menu.

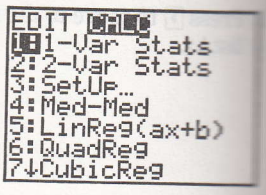
14. Press **7** (to select **RegEQ**). The regression equation for the current model equation (which was calcul using **Med-Med**) is copied to **Y1**.

15. Press [STAT] [▶] **5** (to select **LinReg(ax+b)**). The instruction is copied to the Home screen. Press to calculate the least-squares linea regression.

16. Press [Y=] (to display the Y= editor) [ENTER] (to move to **Y2**) [VARS] (to di the VARS menu) **5** (to select **Statistics...**) [▶] [▶] (to display the VARS EQ menu) **7** (to select **Regl** The current model equation (calcu using **LinReg(ax+b)**) is copied to

ata, set up the statistical calculations.
toring the equations in the Y= list.

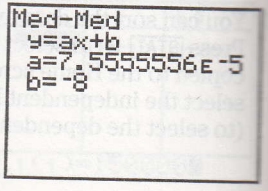
AT



ars.
should

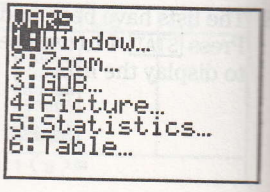
SET UP CALCS
1-Var
Xlist: L1 L2 L3 L4 L5 L6
Freq: 1 L1 L2 L3 L4 L5 L6
2-Var
Xlist: L1 L2 L3 L4 L5 L6
Ylist: L1 L2 L3 L4 L5 L6
Freq: 1 L1 L2 L3 L4 L5 L6

ed),
n is
ENTER
using
model
Home

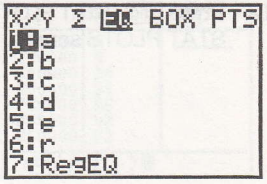


y the

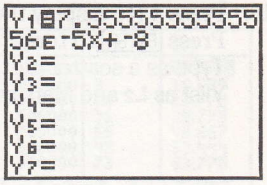
creen.



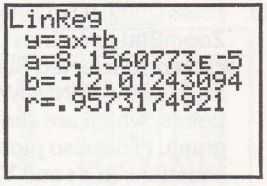
13. Press **5** (to select **Statistics...**) and ▶ ▶ to display the VARS EQ menu.



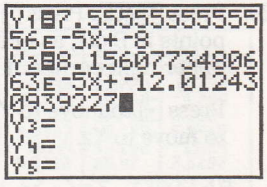
14. Press **7** (to select **RegEQ**). The regression equation for the current model equation (which was calculated using **Med-Med**) is copied to **Y1**.



15. Press STAT ▶ **5** (to select **LinReg(ax+b)**). The instruction is copied to the Home screen. Press ENTER to calculate the least-squares linear regression.



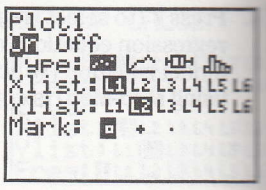
16. Press Y= (to display the Y= editor) ENTER (to move to **Y2**) VARS (to display the VARS menu) **5** (to select **Statistics...**) ▶ ▶ (to display the VARS EQ menu) **7** (to select **RegEQ**). The current model equation (calculated using **LinReg(ax+b)**) is copied to **Y2**.



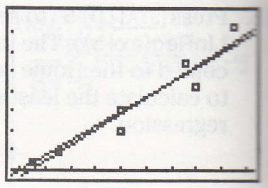
To plot statistical data, you must enter the data in lists and then define the plot. If you have done calculations to fit the data to one or more models and stored the resulting equations in the Y= list, the data and the equations can be shown and traced simultaneously.

17. Press [2nd] [STAT PLOT] to display the STAT PLOTS screen.

18. Press **1** (to display the Plot1 screen). Press [ENTER] to turn Plot1 **On**. Leave Type as a scatter plot, Xlist as **L1**, and Ylist as **L2** and Mark as a □.

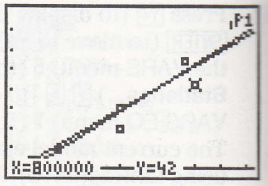


19. Press [ZOOM] **9** (to select **ZoomStat**). **ZoomStat** examines the data for all currently selected Stat Plots and adjusts the viewing WINDOW to include all points, which are shown on the current graph. (This also plots the regression equations in **Y1** and **Y2**.)



20. Press [TRACE]. Press ▶ to trace the points in Plot1, as indicated by **P1** in the upper right corner of the display.

    Press ▼ to move to **Y1**. Press ▼ again to move to **Y2**.



You can enter expressions to defin example, you can define predicted

21. To tell which line better fits the da look at the residuals for both mode Press [STAT] **1** to display the STAT L editor. Press ▶ ▶ ▲ to move the c onto the name **L3**.

    Press [2nd] [Y-VARS] **1** (to select **Function...**) **1** (to select **Y1**) [(] [2nd] [(]. This defines **L3** as the values predicted by the **Med-Med** line.

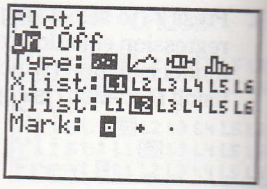
22. Press [ENTER] to store the values in L

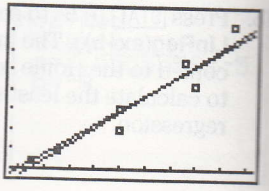
23. To store the residuals for **Med-Med** **L4**, press ▶ ▲ (to move the cursor the name **L4**) [2nd] [L2] (the observe [2nd] [L3] (the predicted) [ENTER].

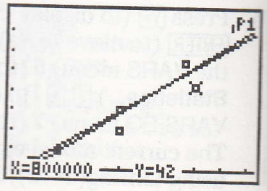
24. Press ▶ ▲ to move onto **L5**. Press [2nd] [Y-VARS] **1** (to select **Function. 2** (to select **Y2**) [(] [2nd] [L1] [)] [ENTE This defines **L5** as the values predi by the **LinReg(ax+b)** line.

25. Press ▶ ▲ (to move the cursor on the name **L6**) [2nd] [L2] (the observe [2nd] [L5] (the predicted) [ENTER] to evaluate and store the residuals fo **LinReg(ax+b)** in **L6**.

enter the data in lists and then define
tions to fit the data to one or more
quations in the Y= list, the data and
raced simultaneously.







You can enter expressions to define lists in the STAT list editor. For example, you can define predicted values and residuals.

21. To tell which line better fits the data, look at the residuals for both models. Press [STAT] **1** to display the STAT list editor. Press [▶] [▶] [▲] to move the cursor onto the name **L3**.

    Press [2nd] [Y-VARS] **1** (to select **Function...**) **1** (to select **Y1**) [(] [2nd] [L1] [)]. This defines **L3** as the values predicted by the **Med-Med** line.

L1	L2	L3
150000	4	------
250000	9	
500000	20	
500000	31	
750000	55	
800000	42	
950000	73	

L3=Y1(L1)

22. Press [ENTER] to store the values in **L3**.

L1	L2	L3
150000	4	3.3333
250000	9	10.889
500000	20	29.778
500000	31	29.778
750000	55	48.667
800000	42	52.444
950000	73	63.778

L3(1)=3.3333333...

23. To store the residuals for **Med-Med** in **L4**, press [▶] [▲] (to move the cursor onto the name **L4**) [2nd] [L2] (the observed) [−] [2nd] [L3] (the predicted) [ENTER].

L2	L3	L4
4	3.3333	.66667
9	10.889	-1.889
20	29.778	-9.778
31	29.778	1.2222
55	48.667	6.3333
42	52.444	-10.44
73	63.778	9.2222

L4(1)=.66666666...

24. Press [▶] [▲] to move onto **L5**. Press [2nd] [Y-VARS] **1** (to select **Function...**) **2** (to select **Y2**) [(] [2nd] [L1] [)] [ENTER]. This defines **L5** as the values predicted by the **LinReg(ax+b)** line.

25. Press [▶] [▲] (to move the cursor onto the name **L6**) [2nd] [L2] (the observed) [−] [2nd] [L5] (the predicted) [ENTER] to evaluate and store the residuals for **LinReg(ax+b)** in **L6**.

L4	L5	L6
.66667	.22169	.77831
-1.889	8.3778	.62224
-9.778	28.768	-8.768
1.2222	28.768	2.232
6.3333	49.158	5.8419
-10.44	53.236	-11.24
9.2222	65.47	7.5297

L6(1)=3.7783149...

You can use the TI-82 to compare different models on the same data set.

26. Press [2nd] [STAT PLOT]. Press **1** to select Plot1. Press [▶] [ENTER] to turn the plot off.

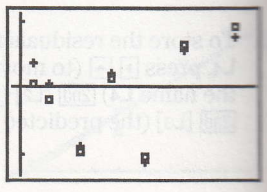
    Press [2nd] [STAT PLOT]. Press **2** to select Plot2. Press [ENTER] to turn the plot on. Press [▼] [▼] [▶] [ENTER] to define Xlist as **L2**. Press [▼] [▶] [▶] [▶] [ENTER] to define Ylist as **L4**. Leave Mark as a □.

27. Press [2nd] [STAT PLOT]. Press **3** to select Plot3. Press [ENTER] to turn the plot on. Press [▼] [▼] [▶] [ENTER] to define Xlist as **L2**. Press [▼] [▶] [▶] [▶] [▶] [▶] [ENTER] to define Ylist as **L6**. Press [▼] [▶] [ENTER] to define Mark as **+**.

    Press [2nd] [STAT PLOT] to view the settings.

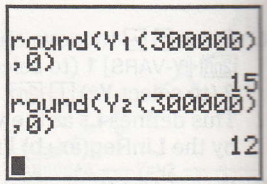
28. Press [Y=] [◀] [ENTER] [▼] [ENTER] to turn off **Y1** and **Y2**.

    Press [ZOOM] **9** to plot the residuals. □ marks the residuals from **Med-Med** and **+** marks the residuals from **LinReg**.



29. Press [2nd] [QUIT] to return to the Home screen. Press [MATH] [▶] **1** (to select **round()** [2nd] [Y-VARS] **1** (to select **Function...**) **1** (to select **Y1**) [(] **300000** [)] [,] **0** [)] [ENTER]. The value of **Y1** (**Med-Med** model) for **X**=300,000, rounded to 0 decimal places (whole buildings), is shown.

    Press [2nd] [ENTRY] [▲] [▶] [2nd] [Y-VARS] **1** **2** [ENTER]. The value of **Y2** (**LinReg(ax+b)** model) for **X**=300,000 is shown.



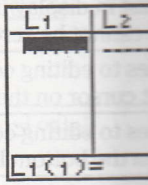
**The data for s
TI-82 has six
stat calculatio
available.**

Steps

1. Enter the s
2. Set up stati
3. Calculate t
   model (pag
4. Plot the da

Displaying the STAT List Editor

To display the
1 or [ENTER] to



The top line d
is empty). The
displays up to
values of the
The full value
rectangular c

Leaving the STAT List Editor

To leave the S

- Select ano
- Press [2nd]

Deleting a List

You can delet

- Use the **CL**
- Through t
- In the STA
  and press
- In the STA
- On a com

different models on the same data

select
lot

select
on.
as
e Ylist

select
on.
as

] to

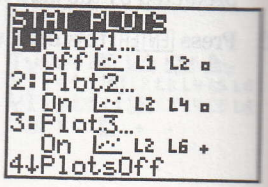
off

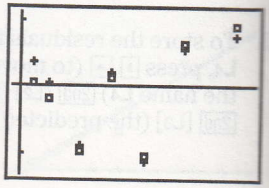
ed
Reg.

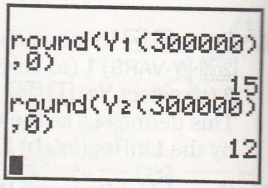
me

000

s] 1
x+b)







Setting Up a Statistical Analysis

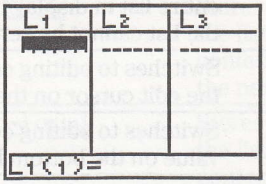
The data for statistical analyses is stored in lists. The TI-82 has six list variables in memory that you can use in stat calculations. Several types of statistical analyses are available.

Steps

1. Enter the stat data in list(s) (pages 12-9 through 12-12).
2. Set up statistical calculations (page 12-13).
3. Calculate the statistical variables or fit the data to a model (page 12-14 through 12-17).
4. Plot the data (page 12-18 through 12-21).

Displaying the STAT List Editor

To display the STAT list editor, press [STAT] and then press **1** or [ENTER] to select **Edit...** from the STAT EDIT menu.



The top line displays the names of the lists (even if the list is empty). The center portion of the STAT list editor displays up to seven elements of three lists, showing the values of the elements in abbreviated form if necessary. The full value of the current element (indicated by the rectangular cursor) is shown on the bottom line.

Leaving the STAT List Editor

To leave the STAT list editor:

- Select another screen by pressing the appropriate key.
- Press [2nd] [QUIT] to return to the Home screen.

Deleting a List

You can delete the contents of a list in several ways:

- Use the **ClrList** instruction (page 12-12).
- Through the MEM menu (Chapter 16).
- In the STAT editor, press [▲] to move onto the list name, and press [CLEAR] [ENTER].
- In the STAT editor, delete each element.
- On a command line, enter **0→dim** *listname*.

Viewing List Elements

The STAT list editor has two "contexts," viewing and editing. The current context determines the result of a keypress.

Viewing Context Keys

In viewing context, you can move quickly from one list element to the next. The full value of the current element is displayed on the bottom line.

◀ or ▶	Moves the rectangular cursor within the current row.
▼ or ▲	Moves the rectangular cursor within the current column. On row 1, ▲ moves the cursor to the list name and shows the entire list in display input format, but the list cannot be scrolled).
ENTER	Switches to editing context; activates the edit cursor on the bottom line.
CLEAR	Switches to editing context; clears the value on the bottom line.
Any entry character	Switches to editing context; clears the value on the bottom line; copies the character to the bottom line.
2nd [INS]	Inserts a list element (value is zero).
DEL	Deletes the current list element (closes up list).

Editing List Elements

In the editing con bottom line, and y list element. You edit the entire list

Editing Context Keys

◀ or ▶	
CLEAR	
Any entry character	
2nd [INS]	
DEL	
ENTER	
▼ or ▲	

Editing a List Element

1. Move the recta change.
2. Switch to editi
   - Press ENTER deleting, or
   - Press CLEA enter a new followed by rectangular
   - Press an en begin an en
3. Enter the valu evaluated whe
4. Press ENTER.

r has two "contexts," viewing and
t context determines the result of a

you can move quickly from one list
The full value of the current element
ottom line.

oves the rectangular cursor within the
rrent row.

oves the rectangular cursor within the
rrent column. On row 1, ▲ moves the
rsor to the list name and shows the
tire list in display input format, but
e list cannot be scrolled).

itches to editing context; activates
e edit cursor on the bottom line.

itches to editing context; clears the
ue on the bottom line.

itches to editing context; clears the
ue on the bottom line; copies the
aracter to the bottom line.

erts a list element (value is zero).

etes the current list element (closes
list).

Editing List Elements

In the editing context, an edit cursor is active on the bottom line, and you can change the value of the current list element. You can also move onto the list name and edit the entire list at once.

Editing Context Keys

◀ or ▶	Moves the edit cursor within the value.
CLEAR	Clears the value on the bottom line.
Any entry character	Copies the character to the location of the edit cursor on the bottom line. If it is the first character typed, the value on the bottom line is cleared.
2nd [INS]	Activates insert cursor.
DEL	Deletes character.
ENTER	Stores the value on the bottom line to the list element; switches to viewing context. Rectangular cursor moves to the next element.
▼ or ▲	Stores the value on the bottom line to the list element; switches to viewing context and moves the rectangular cursor within the column.

Editing a List Element

1. Move the rectangular cursor to the element you want to change.
2. Switch to editing context.
   - Press ENTER to change the value by inserting, deleting, or typing over digits.
   - Press CLEAR to clear the entire value so you can enter a new value. **Note:** You can press CLEAR, followed by ENTER to restore the value at the rectangular cursor if you make a mistake.
   - Press an entry key, such as a number or letter, to begin an entry. This automatically clears the value.
3. Enter the value. You may enter an expression (which is evaluated when you leave editing context).
4. Press ENTER, ▲, or ▼ to move to another element.

STAT EDIT Menu

Pressing [STAT] accesses the STAT list editor and several instructions for use with lists.

STAT EDIT Menu

```
EDIT  CALC
1:Edit...          Displays list editor (page 12-9).
2:SortA(           Sorts list in ascending order
3:SortD(           Sorts list in ascending order
4:ClrList          Deletes all elements of list
```

Note: SortA(and **SortD(** are the same as **SortA(** and **SortD(** on the LIST OPS menu.

SortA(
SortD(

SortA((sort ascending) and **SortD(** (sort descending) have two uses.

- With one *listname*, they sort the elements of an existing list and update the list in memory.
- With two to six *listnames*, they sort the first list and then sort the remaining lists as dependent lists, element by element, and update the lists in memory. All lists must be the same length.

SortA(*listname***)**
SortA(*listnameI*,*listnameD*,*listnameD*, . . .**)**

```
{5,4,3}→L3:{1,2,
3}→L4:SortA(L3,L
4):L3
                {3 4 5}
L4
                {3 2 1}
```

ClrList

ClrList clears (deletes) the elements of one or more *listnames*.

ClrList *listnameA*,*listnameB*, . . .

Statistical Analysis

Pressing [STAT] ▶ ac you set up and perf can analyze one-va can have associate

CALC Menu

```
EDIT  CALC
1:1-Var Stats
2:2-Var Stats
3:SetUp...
4:Med-Med
5:LinReg(ax+b)
6:QuadReg
7:CubicReg
8:QuartReg
9:LinReg(a+bx)
0:LnReg
A:ExpReg
B:PwrReg
```

SET UP CALCS screen

When you select **Se** appears, where you

```
SET UP CALCS
1-Var Stats
Xlist: L1 L2 L3 L4
Freq: 1 L1 L2 L3 L4
2-Var Stats
Xlist: L1 L2 L3 L4
Ylist: L1 L2 L3 L4
Freq: 1 L1 L2 L3 L4
```

- **1-Var Stats** (one one measured va
- **2-Var Stats** (two data between wh independent var
- **Freq** (frequency between 0 and 9 default is **1**. It is statistics.

Note: You can over specifying the nam calculation instruct

Changing Settings

To change a setting ▲, ▶, and ◀ to po

ccesses the STAT list editor and several
use with lists.

Displays list editor (page 12-9).
Sorts list in ascending order
Sorts list in ascending order
Deletes all elements of list

SortD(are the same as **SortA(** and
T OPS menu.

ding) and **SortD(** (sort descending) have

me, they sort the elements of an existing
the list in memory.

listnames, they sort the first list and
maining lists as dependent lists, elements
update the lists in memory. All lists
e length.

stnameD,*listnameD*, . . .)

```
,2,
3,L
 5)
 1)
```

es) the elements of one or more

stnameB, . . .

Statistical Analysis

Pressing [STAT] ▶ accesses the STAT CALC menu, where you set up and perform statistical calculations. The TI-82 can analyze one-variable or two-variable statistics. Both can have associated frequencies.

STAT CALC Menu

```
EDIT  CALC
1:1-Var Stats
2:2-Var Stats
3:SetUp...
4:Med-Med
5:LinReg(ax+b)
6:QuadReg
7:CubicReg
8:QuartReg
9:LinReg(a+bx)
0:LnReg
A:ExpReg
B:PwrReg
```

1:1-Var Stats	Calculates 1-variable statistics
2:2-Var Stats	Calculates 2-variable statistics
3:SetUp...	Defines lists to use in calculations
4:Med-Med	Calculates median-median line
5:LinReg(ax+b)	Fits data to linear model
6:QuadReg	Fits data to quadratic model
7:CubicReg	Fits data to cubic model
8:QuartReg	Fits data to quartic model
9:LinReg(a+bx)	Fits data to linear model
0:LnReg	Fits data to logarithmic model
A:ExpReg	Fits data to exponential model
B:PwrReg	Fits data to power model

SET UP CALCS Screen

When you select **SetUp...**, the SET UP CALCS screen appears, where you can define a statistical analysis.

```
SET UP CALCS
1-Var Stats
Xlist: L1 L2 L3 L4 L5 L6
Freq: 1 L1 L2 L3 L4 L5 L6
2-Var Stats
Xlist: L1 L2 L3 L4 L5 L6
Ylist: L1 L2 L3 L4 L5 L6
Freq: 1 L1 L2 L3 L4 L5 L6
```

- **1-Var Stats** (one-variable statistics) analyzes data with one measured variable.
- **2-Var Stats** (two-variable statistics) analyzes paired data between which there is a relationship. **Xlist** is the independent variable. **Ylist** is the dependent variable.
- **Freq** (frequency of occurrence) is a list of integers between 0 and 99 (inclusive). **Freq** is optional; the default is **1**. It is valid for one-variable or two-variable statistics.

Note: You can override SET UP CALCS settings by specifying the name(s) of the list(s) after the statistical calculation instruction (Appendix A).

Changing Settings

To change a setting on the SET UP CALCS screen, use ▼, ▲, ▶, and ◀ to position the cursor and then press [ENTER].

Statistical Variables

The statistical variables are calculated as indicated below. Some are displayed when 1-Var Stats or 2-Var Stats are calculated. You can access these variables for use in expressions through the VARS Statistics... menus. If a list is edited, all statistical variables are cleared.

Variables	1-Var Stats	2-Var Stats	Other	VARS Menu
mean of **x** values	$\bar{x}$	$\bar{x}$		X/Y
sum of **x** values	Σx	Σx		Σ
sum of x^2 values	Σx^2	Σx^2		Σ
sample standard deviation of **x**	**Sx**	**Sx**		X/Y
population standard deviation of **x**	σx	σx		X/Y
number of data points	**n**	**n**		X/Y
mean of **y** values		$\bar{y}$		X/Y
sum of **y** values		Σy		Σ
sum of y^2 values		Σy^2		Σ
sample standard deviation of **y**		**Sy**		X/Y
population standard deviation of **y**		σy		X/Y
sum of **x** * **y**		Σxy		Σ
minimum of **x** values	**minX**	**minX**		X/Y
maximum of **x** values	**maxX**	**maxX**		X/Y
minimum of **y** values		**minY**		X/Y
maximum of **y** values		**maxY**		X/Y
1st quartile	Q_1			BOX
median	**Med**			BOX
3rd quartile	Q_3			BOX
regression/fit coefficients			**a, b**	EQ
polynomial coefficients			**a, b, c, d, e**	EQ
correlation coefficient			**r**	EQ
regression equation			**RegEQ**	EQ
summary points (**Med-Med** only)			$x_1, y_1, x_2, y_2, x_3, y_3$	PTS

Q_1 and Q_3 The quartile Q_1 is the median of the ordinals to the left of **Med**. The quartile Q_3 is the median of the ordinals to the right of **Med**.

Types of Statistical Analys

The SET UP CALC analyses. You ca specifying the na the statistical calc

1-Var Stats (one-v calculates statistic page.

2-Var Stats (two-v calculates statistic page.

Med-Med (median- data to the model (resistant line) tec x_1, y_1, x_2, y_2, x_3, a (y-intercept).

LinReg (ax+b) (lin the data to the mo **x** and **y**. It displays (correlation coeffi

QuadReg (quadrat the data to the sec displays **a**, **b**, and polynomial fit; for regression. At leas

CubicReg (cubic r data to the third-o displays **a**, **b**, **c**, an polynomial fit; for regression. At leas

QuartReg (quartic data to the fourth- It displays **a**, **b**, **c**, polynomial fit; for regression. At leas

variables are calculated as indicated
re displayed when 1-Var Stats or
calculated. You can access these
se in expressions through the VARS
nus. If a list is edited, all statistical
eared.

1-Var Stats	2-Var Stats	Other	VARS Menu
$\bar{x}$	$\bar{x}$		X/Y
Σx	Σx		Σ
Σx^2	Σx^2		Σ
Sx	Sx		X/Y
σx	σx		X/Y
n	n		X/Y
	$\bar{y}$		X/Y
	Σy		Σ
	Σy^2		Σ
	Sy		X/Y
	σy		X/Y
	Σxy		Σ
minX	minX		X/Y
maxX	maxX		X/Y
	minY		X/Y
	maxY		X/Y
Q_1			BOX
Med			BOX
Q_3			BOX
		a, b	EQ
		a, b, c, d, e	EQ
		r	EQ
		RegEQ	EQ
		x_1, y_1, x_2, y_2, x_3, y_3	PTS

the median of the ordinals to the left of Q_3 is the median of the ordinals to the

Types of Statistical Analysis

The SET UP CALCS settings are used for statistical analyses. You can override SET UP CALCS settings by specifying the name(s) of the list(s) and frequency after the statistical calculation instruction (Appendix A).

1-Var Stats **1-Var Stats** (one-variable statistics, STAT CALC item 1) calculates statistical variables as indicated on the previous page.

2-Var Stats **2-Var Stats** (two-variable statistics, STAT CALC item 2) calculates statistical variables as indicated on the previous page.

Med-Med **Med-Med** (median-median, STAT CALC item 4) fits the data to the model **y=ax+b** using the median-median line (resistant line) technique, calculating the summary points x_1, y_1, x_2, y_2, x_3, and y_3. It displays **a** (slope) and **b** (y-intercept).

LinReg (ax+b) **LinReg (ax+b)** (linear regression, STAT CALC item 5) fits the data to the model **y=ax+b** using a least-squares fit and **x** and **y**. It displays **a** (slope), **b** (**y**-intercept), and **r** (correlation coefficient).

QuadReg **QuadReg** (quadratic regression, STAT CALC item 6) fits the data to the second-order polynomial $y=ax^2+bx+c$. It displays **a**, **b**, and **c**. For three points the equation is a polynomial fit; for four or more, it is a polynomial regression. At least three points are required.

CubicReg **CubicReg** (cubic regression, STAT CALC item 7) fits the data to the third-order polynomial $y=ax^3+bx^2+cx+d$. It displays **a**, **b**, **c**, and **d**. For four points the equation is a polynomial fit; for five or more, it is a polynomial regression. At least four points are required.

QuartReg **QuartReg** (quartic regression, STAT CALC item 8) fits the data to the fourth-order polynomial $y=ax^4+bx^3+cx^{2+}dx+e$. It displays **a**, **b**, **c**, **d**, and **e**. For five points the equation is a polynomial fit; for six or more, it is a polynomial regression. At least five points are required.

LinReg (a+bx)	**LinReg (a+bx)** (linear regression, STAT CALC item 9) fits the data to the model equation **y=a+bx** using a least-squares fit and **x** and **y**. It displays **a** (y-intercept), **b** (slope), and **r** (correlation coefficient).
LnReg	**LnReg** (logarithmic regression, STAT CALC item 0) fits the data to the model equation **y=a+b ln(x)** using a least-squares fit and transformed values **ln(x)** and **y**. It displays **a**, **b**, and **r** (correlation coefficient).
ExpReg	**ExpReg** (exponential regression, STAT CALC item A) fits the data to the model equation $y=ab^x$ using a least-squares fit and transformed values **x** and **ln(y)**. It displays **a** (y-intercept), **b**, and **r** (correlation coefficient).
PwrReg	**PwrReg** (power regression, STAT CALC item B) fits the data to the model equation $y=ax^b$ using a least-squares fit and transformed values **ln(x)** and **ln(y)**. It displays **a**, **b**, and **r** (correlation coefficient).

You can enter statis and fit data to mode

Entering Stat Data

Enter statistical dat

Statistical Calculations

1. On a blank line i calculation from
2. You can enter th calculation or us **Note:** You cannc program editor.

```
PROGRAM:STA
:LinReg(ax+
,L2
```

ear regression, STAT CALC item 9) fits
del equation **y=a+bx** using a least-
nd **y**. It displays **a** (**y**-intercept),
rrelation coefficient).

c regression, STAT CALC item 0) fits the
equation **y=a+b ln(x)** using a least-
sformed values **ln(x)** and **y**. It displays
tion coefficient).

ial regression, STAT CALC item A) fits
del equation $y=ab^x$ using a least-squares
l values **x** and **ln(y)**. It displays **a**
d **r** (correlation coefficient).

gression, STAT CALC item B) fits the
quation $y=ax^b$ using a least-squares fit
lues **ln(x)** and **ln(y)**. It displays **a**, **b**, and
icient).

Statistical Analysis in a Program

You can enter statistical data, calculate statistical results, and fit data to models from a program.

Entering Stat Data

Enter statistical data into lists directly (Chapter 11).

Statistical Calculations

1. On a blank line in the program editor, select the type of calculation from the STAT CALC menu.
2. You can enter the names of the lists to use in the calculation or use the lists defined in SET UP CALCS. **Note:** You cannot access SET UP CALCS from the program editor.

```
PROGRAM:STATS
:LinReg(ax+b) L1
,L2
```

Statistical Plotting

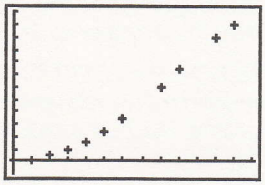
You can plot statistical data that you have entered in lists. The types of plots available include scatter plots, x-y lines, box and whisker plots, and histograms. You can define up to three plots at a time.

Steps

1. Enter the stat data in list(s) (page 12-9 through 12-12 and Chapter 11).
2. Set up statistical calculations (page 12-13) and calculate the statistical variables or fit the data to a model (page 12-14 through 12-17), if desired.
3. Select or deselect Y= equations as appropriate (Chapter 3).
4. Define the stat plot (page 12-21).
5. Turn plot(s) on, if necessary (page 12-21).
6. Define the viewing WINDOW (page 12-21 and Chapter 3).
7. Display and explore the graph (Chapter 3).

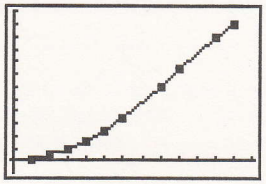
Scatter Plot

Scatter plots the data points from Xlist and Ylist as coordinate pairs, showing each point as a box (□), cross (+), or dot (•). Xlist and Ylist must be the same length. They can be the same list. Freq does not apply.



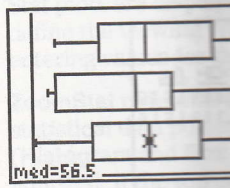
xyLine

xyLine is a **Scatter** plot in which the data points are plotted and connected in the order in which they appear in Xlist and Ylist. You may want to sort the lists with **SortA(** or **Sort(D** before plotting.

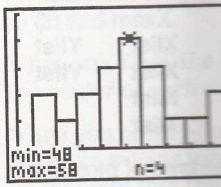


Boxplot plots one-var
extend from the minim
the first quartile (Q1)
the maximum point (
median (**Med**), and Q

Box plots ignore **Ymi**
respect to **Xmin** and **X**
plotted, the first plots
the bottom. When thr
plots on the top and t



Histogram plots one-
width of each bar, be
Xmin and **Xmax** to in
Xscl. **(Xmax–Xmin)/X**
on the edge of a bar i



stical data that you have entered in
plots available include scatter plots,
whisker plots, and histograms. You
hree plots at a time.

ata in list(s) (page 12-9 through 12-12
).

l calculations (page 12-13) and
atistical variables or fit the data to a
-14 through 12-17), if desired.

ct Y= equations as appropriate

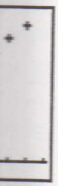
lot (page 12-21).

if necessary (page 12-21).

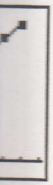
ng WINDOW (page 12-21 and

lore the graph (Chapter 3).

ta points from Xlist and Ylist as
owing each point as a box (□), cross
and Ylist must be the same length. They
. Freq does not apply.



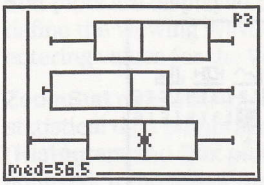
plot in which the data points are
ed in the order in which they appear in
ay want to sort the lists with **SortA(** or
ng.



Boxplot

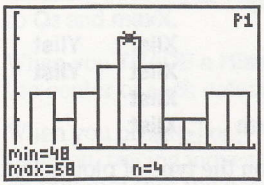
Boxplot plots one-variable data. The whiskers on the plot extend from the minimum data point in the set (**minX**) to the first quartile (Q_1) and from the third quartile (Q_3) to the maximum point (**maxX**). The box is defined by Q_1, the median (**Med**), and Q_3. (page 12-14)

Box plots ignore **Ymin** and **Ymax**, but are plotted with respect to **Xmin** and **Xmax**. When two box plots are plotted, the first plots in the middle and the second plots in the bottom. When three box plots are plotted, the first plots on the top and the third plots on the bottom.



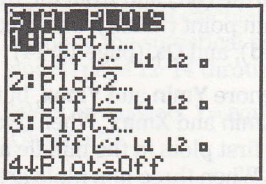
Histogram

Histogram plots one-variable data. **Xscl** determines the width of each bar, beginning at **Xmin**. **ZoomStat** adjusts **Xmin** and **Xmax** to include all values, but does not change **Xscl**. **(Xmax–Xmin)/Xscl** must be ≤ 47. A value occurring on the edge of a bar is counted in the bar to the right.

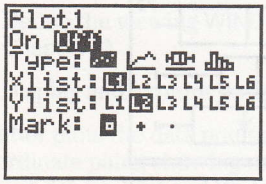


Defining the Plots

1. Press 2nd [STAT PLOT]. The STAT PLOTS screen shows the current plot definitions.



2. Select the plot to define (Plot1, Plot2, or Plot3).



3. If you wish to plot the statistical data immediately, select **On**. You can define a plot at any time and leave it **Off**. The definition will be available in the future.

4. Select the type of plot. The options change appropriately:

• **Scatter:**	**Xlist**	**Ylist**		**Mark**
• **xyLine:**	**Xlist**	**Ylist**		**Mark**
• **Boxplot:**	**Xlist**		**Freq**	
• **Histogram:**	**Xlist**		**Freq**	

5. Depending on the type of plot, select the options:

- **Xlist** (independent data)
- **Ylist** (dependent data)
- **Freq** (frequency, **1** is used if not specified)
- **Mark** (□, +, or •)

Turning Plots Off or On

PlotsOff and **PlotsOn** from the Home scree they turn all plots on turn specific plots on

PlotsOff or **PlotsOn**
PlotsOff *plot#,plot#,*
PlotsOn *plot#*

For example, **PlotsO** then turns Plot3 on.

Defining the Viewing WINDOW

Stat plots are displa define the viewing W entering values for t

ZoomStat redefines statistical data point (**Histogram** and **Box** adjusted. If the top o TRACE to determine

Tracing a Stat Plot

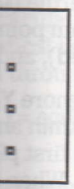
When you TRACE a at the first element i

When you TRACE a median). Press ◄ to to **Q3** and **maxX**.

When you TRACE a top center of each c

When you press ▲ o function, tracing mo on that plot (not the

LOT]. The STAT PLOTS screen shows
efinitions.



lefine (Plot1, Plot2, or Plot3).

the statistical data immediately,
define a plot at any time and leave it
will be available in the future.

lot. The options change

Xlist	Ylist		Mark
Xlist	Ylist		Mark
Xlist		Freq	
Xlist		Freq	

ype of plot, select the options:

ent data)
t data)
, 1 is used if not specified)

Turning Plots Off or On

PlotsOff and **PlotsOn** allow you to turn stat plots on or off from the Home screen or a program. Used without *plot#*, they turn all plots on or all plots off. Used with *plot#*, they turn specific plots on or off.

PlotsOff or **PlotsOn**
PlotsOff *plot#*,*plot#*, . . .
PlotsOn *plot#*

For example, **PlotsOff:PlotsOn 3** turns all plots off and then turns Plot3 on.

Defining the Viewing WINDOW

Stat plots are displayed on the current graph. You may define the viewing WINDOW by pressing [WINDOW] and then entering values for the WINDOW variables.

ZoomStat redefines the viewing WINDOW so that all statistical data points are displayed. For one-variable plots (**Histogram** and **Box plot**), only **Xmin** and **Xmax** are adjusted. If the top of the histogram is not shown, use TRACE to determine the value for **Ymax**.

Tracing a Stat Plot

When you TRACE a **Scatter** plot or **xyLine**, tracing begins at the first element in the lists.

When you TRACE a **Box** plot, tracing begins at **Med** (the median). Press [◀] to trace to $\mathbf{Q_1}$ and **minX**. Press [▶] to trace to $\mathbf{Q_3}$ and **maxX**.

When you TRACE a **Histogram**, the cursor moves from the top center of each column.

When you press [▲] or [▼] to move to another plot or Y= function, tracing moves to the current or beginning point on that plot (not the nearest pixel).

You may define a plot, select or deselect a plot, and display a plot from a program

Stat Plots

To display a stat plot, you may define the plot(s), then turn on the plot(s), and then display the graph. (If you do not define the plot, the current definitions are used).

For example:

```
PROGRAM:STAT
:{55,62,88,43,94
,61}→L1
:Plot1(BoxPlot,L
1)
:FnOff
:PlotsOn 1
:ZoomStat
```

Defining a Stat Plot

1. Begin on a blank line in the program editor. Press 2nd [STAT PLOT] to display the STAT PLOTS menu.

```
PLOTS TYPE MARK
1:Plot1(
2:Plot2(
3:Plot3(
4:PlotsOff
5:PlotsOn
```

2. Select the plot to define. **Plot1**, **Plot2**, or **Plot3** is copied to the cursor location.
3. Press 2nd [STAT PLOT] ▶ to display the STAT TYPES menu. Select the type of plot. **Scatter**, **xyLine**, **Boxplot**, or **Histogram** is copied to the cursor location.
4. Press , then enter list names. See Appendix A for the appropriate options.
5. Select the type of mark (for **Scatter** or **xyLine**).

Displaying a Stat Plot

To display a plot, use the **DispGraph** instruction or any of the ZOOM instructions.

This chapter desc instructions and h the TI-82.

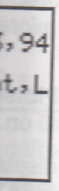
Chapter Contents

Getting Started: F
About TI-82 Progr
Creating and Exec
Editing Programs
PRGM CTL (Contr
PRGM I/O (Input/
Calling Other Prog

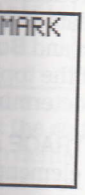
ogram

plot, select or deselect a plot, and
n a program

ot, you may define the plot(s), then turn
then display the graph. (If you do not
current definitions are used).



line in the program editor. Press
to display the STAT PLOTS menu.



define. **Plot1**, **Plot2**, or **Plot3** is copied
tion.

LOT] ▶ to display the STAT TYPES
ype of plot. **Scatter**, **xyLine**, **Boxplot**,
opied to the cursor location.

er list names. See Appendix A for the
ns.

mark (for **Scatter** or **xyLine**).

the **DispGraph** instruction or any of
ns.

Chapter 13: Programming

This chapter describes specific programming instructions and how to enter and execute programs on the TI-82.

Chapter Contents

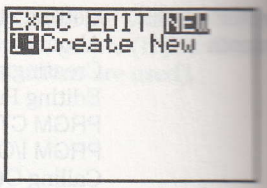
Getting Started: Family of Curves 13-2
About TI-82 Programs 13-4
Creating and Executing Programs 13-5
Editing Programs 13-6
PRGM CTL (Control) Instructions 13-7
PRGM I/O (Input/Output) Instructions 13-13
Calling Other Programs 13-18

Getting Started: Family of Curves

Getting Started is a fast-paced introduction. Read the chapter for details.

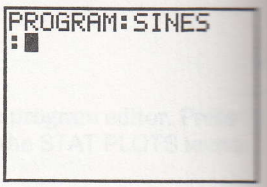
A program is a set of commands that can be executed sequentially, as if they had been entered from the keyboard. Write a simple program to graph the family of curves 2 sin X, 4 sin X, and 6 sin X.

1. Press PRGM ▶ ▶ to display the PRGM NEW menu.



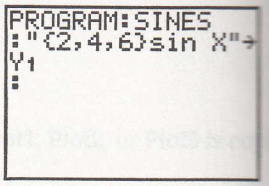
2. Press ENTER (to select **Create New...**). Type **S I N E S** as the name of the program (the keyboard is in ALPHA-LOCK), and press ENTER.

   You are now in the program editor. Note the **:** (colon) in the first column of the second line to indicate that this is the beginning of a command line.



3. Press ALPHA ["] (above +) 2nd [{] **2** , **4** , **6** 2nd [}] SIN X,T,Θ ALPHA ["] STO▸ 2nd [Y-VARS]. Press ENTER (to select **Function...**). Press ENTER (to select **Y1**).

   This instruction stores the function **{2,4,6}sin X** to **Y1**.



4. Press ENTER to complete the instruction and move to the next line. The **:** (colon) indicates the beginning of the second command line.

5. Press ZOOM. The ZOOM menu appears, just as it does elsewhere. Press **6** (to select **ZStandard**). The instruction **ZStandard** is copied to the cursor location. Press ENTER to complete the instruction.

6. Press TRACE. The instruction **Trace** is copied to the cursor location. Press ENTER to complete the instruction.

7. Press 2nd [QUIT] to return to the Home screen.

8. Press PRGM to display the PRGM menu.

9. Select **SINES**. The instruction **prgmSINES** is copied to the Home screen.

10. Press ENTER to execute the instruction. The three curves are graphed immediately, then the dotted "pause" indicator appears in the upper right of the display to indicate that the program will not resume execution until you press ENTER.

11. Use ◀, ▲, ▶, and ▼ to trace the curves.

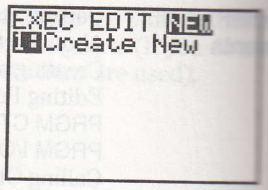
12. When you are done tracing, press ENTER. The program continues. (In this case it ends.) The graph remains on the screen for you to examine.

13. Press Y= to display the Y= editor. Notice that **Y1** now contains the function you stored to it in the program.

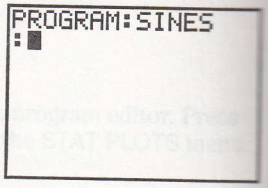
ntroduction. Read the chapter for details.

s that can be executed sequentially.
n the keyboard. Write a simple program to
X, 4 sin X, and 6 sin X.

PRGM



ew...).
e
'HA-

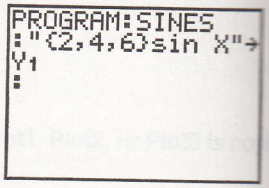


or. Note
of the
s the

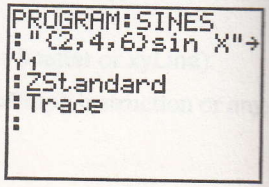
] 2 ,
] STO▸
ect
ct Y1).

on

ruction
(colon)
ond



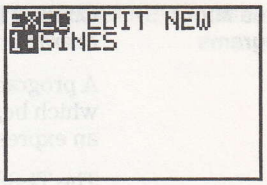
pears,
(to
n
r
the



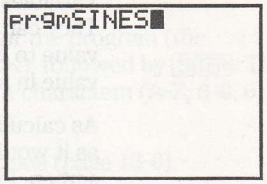
e is
ss

7. Press [2nd] [QUIT] to return to the Home screen.

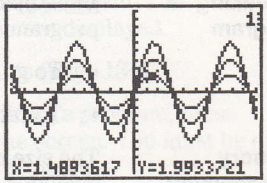
8. Press [PRGM] to display the PRGM menu.



9. Select **SINES**. The instruction **prgmSINES** is copied to the Home screen.



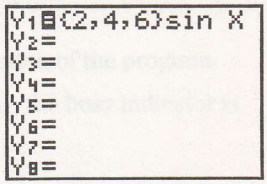
10. Press [ENTER] to execute the instruction. The three curves are graphed immediately, then the dotted "pause" indicator appears in the upper right of the display to indicate that the program will not resume execution until you press [ENTER].



11. Use [◀], [▲], [▶], and [▼] to trace the curves.

12. When you are done tracing, press [ENTER]. The program continues. (In this case it ends.) The graph remains on the screen for you to examine.

13. Press [Y=] to display the Y= editor. Notice that **Y1** now contains the function you stored to it in the program.



About TI-82 Programs

Most features of the TI-82 are accessible from programs. Programs can access all variables and named items. The number of programs that the TI-82 can store is limited only by available memory.

Notes about Programs

On the TI-82, programs are identified by names, up to eight characters, beginning with a letter.

A program consists of a series of program commands, which begin with a : (colon). A program command can be an expression or an instruction.

The TI-82 checks for errors when the program is executed, not as you enter or edit the program.

Variables, lists, and matrices saved in memory are global. They can be accessed from all programs. Storing a new value to a variable, list, or matrix in a program changes the value in memory during program execution.

As calculations are made in programs, **Ans** is updated, just as it would be if the calculations were done on the Home screen. Programs do not update Last Entry as each command is executed.

"Breaking" a Program

[ON] stops program execution. When you press [ON] to stop program execution, the ERR: BREAK screen is displayed.

- To go to where the interrupt occurred, select **Goto**.
- To return to the Home screen, select **Quit**.

Memory Management and Erasing Programs

The size of programs you can store is limited only by available memory. To access the memory management menu, press [2nd] [MEM] from the Home screen. Memory status is displayed on the Check RAM... screen. To increase available memory, delete items, including other programs, from the MEM DELETE FROM... screen (Chapter 15).

Creating and Executing Progr

The program editor is then choosing to crea existing program.

Creating a New Program

1. Press [PRGM] [▶] [▶] to Select **Create New**.

```
PROGRAM
Name=
```

2. Enter the name you keyboard is in ALP name may have on and must begin wit
3. Enter the program

Editing a Program

1. Press [PRGM] [▶] to d
2. Select the name of instructions in that
3. Edit the program i

Leaving the Program Editor

When you finish enteri [2nd] [QUIT] to return to the Home screen to ex

Executing a Program

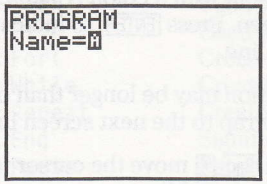
1. From a blank line display the PRGM
2. Select the name of name of the progra for example, **prgm**
3. Press [ENTER] to beg

While the program is displayed.

The program editor is accessed by pressing PRGM and then choosing to create a new program or edit an existing program.

Creating a New Program

1. Press PRGM ▶ ▶ to display the PRGM NEW menu. Select **Create New**.



2. Enter the name you want for the program (the keyboard is in ALPHA-LOCK), followed by ENTER. The name may have one to eight characters (A-Z, 0-9, θ) and must begin with a letter.
3. Enter the program instructions (page 13-6).

Editing a Program

1. Press PRGM ▶ to display the PRGM EDIT menu.
2. Select the name of an existing program. The instructions in that program are displayed.
3. Edit the program instructions (page 13-6).

Leaving the Program Editor

When you finish entering or editing a program, press 2nd [QUIT] to return to the Home screen. You must be on the Home screen to execute a program.

Executing a Program

1. From a blank line on the Home screen, press PRGM to display the PRGM EXEC menu.
2. Select the name of an existing program. **prgm** and the name of the program are copied to the Home screen; for example, **prgmSINES**.
3. Press ENTER to begin execution of the program.

While the program is executing, the busy indicator is displayed.

In general, anything that can be executed from the Home screen can be included in a program, and vice versa. A program command always begins with a colon.

Entering Program Commands

A colon indicates the beginning of each program command. To enter more than one instruction on a line, separate them with a colon (Chapter 1), just as on the Home screen. Press [ENTER] to indicate the end of a command line.

An instruction may be longer than one line on the screen; if so, it will wrap to the next screen line.

[2nd] [◀] and [2nd] [▶] move the cursor to the beginning and end of a command line.

In the program editor, if you press a key that accesses a menu, the menu screen temporarily replaces the program edit screen. When you make a selection or press [CLEAR], you are returned to the program editor.

Changing

Move the cursor to the command.

- Position the cursor and then make the changes.
- Press [CLEAR] to clear (blank) all program commands on the command line (the leading colon is not deleted), and then enter a new program command.

Inserting

To insert a new command line, position the cursor where you want the new line, press [2nd] [INS] to put the TI-82 in insert mode, and press [ENTER].

Deleting

To delete a command line, press [CLEAR] to clear the line and then press [DEL] to delete the colon.

Copying a Program

RCL (Chapter 1) copies (inserts) all of the commands of one program into another, which you then can edit.

- You can create templates for frequently used groups of instructions, such as setting WINDOW variables.
- You can make copies of programs.

To recall a program, press [2nd] [RCL] [PRGM] [◀] to display the PRGM EXEC menu, then select the name of the program and press [ENTER].

The PRGM CTL (pro accessed only from [PRGM]). They direct t They make it easy to during program exe the menu, the name

PRGM CTL Menu

```
CTL I/O EXEC
1:If
2:Then
3:Else
4:For(
5:While
6:Repeat
7:End
8:Pause
9:Lbl
0:Goto
A:IS>(
B:DS<(
C:Menu(
D:prgm
E:Return
F:Stop
```

Controlling Program Flow

Program control ins command to execut **Repeat** check a *con* what command to e relational or Boolea **If A<7:A+1→A** or **If**

If

If is used for testing (zero), then the com skipped. If *conditio* executed. **If** instruct

:If *condition*
:*command if true*
:*command*

PRGM CTL (Control) Instructions

The PRGM CTL (program control) instructions can be accessed only from within the program editor (press [PRGM]). They direct the flow within an executing program. They make it easy to repeat or skip a group of commands during program execution. When you select an item from the menu, the name is copied to the cursor location.

PRGM CTL Menu

CTL I/O EXEC	
1:If	Create conditional test
2:Then	Used with **If**
3:Else	Used with **If-Then**
4:For(	Create incrementing loop
5:While	Create conditional loop
6:Repeat	Create conditional loop
7:End	Signifies end of loop, **If-Then**, or **Else**
8:Pause	Pause program execution
9:Lbl	Define a label
0:Goto	Go to a label
A:IS>(	Increment and skip if greater than
B:DS<(	Decrement and skip if less than
C:Menu(	Define menu items and branches
D:prgm	Execute a program as a subroutine
E:Return	Return from a subroutine
F:Stop	Stops execution

Controlling Program Flow

Program control instructions tell the TI-82 which command to execute next in a program. **If**, **While**, and **Repeat** check a *condition* that you define to determine what command to execute next. *condition* frequently uses relational or Boolean tests (Chapter 2) such as **If A<7:A+1→A** or **If N=1 and M=1:Goto Z.**

If

If is used for testing and branching. If *condition* is false (zero), then the command immediately following it is skipped. If *condition* is true (nonzero), that command is executed. **If** instructions can be nested.

:If *condition*
:command if true
:command

If-Then

Then following an **If** executes a group of commands if *condition* is true (nonzero). **End** identifies the end of the group. (PRGM CTL item 2)

:If *condition*
:Then
:*command if true*
:*command if true*
:End
:*command*

If-Then-Else

Else following **If-Then** executes a group of commands if *condition* is false (zero). **End** identifies the end of the group. (PRGM CTL item 3)

:If *condition*
:Then
:*command if true*
:*command if true*
:Else
:*command if false*
:*command if false*
:End
:*command*

For(

For(is used for looping and incrementing. It increments *variable* from *begin* to *end*, by *increment*. *increment* is optional (if not specified, 1 is used) and can be negative (*end*<*begin*). *end* is a maximum or minimum value not to be exceeded. **End** identifies the end of the loop. **For(** loops can be nested. (PRGM CTL item 4)

:For(*variable*,*begin*,*end*,*increment*)
:*command while end not exceeded*
:*command while end not exceeded*
:End
:*command*

For example, **For(A,0,10,2):Disp A²:End**, displays **0**, **4**, **16**, **36**, **64**, and **100**.

If executes a group of commands if
nonzero). **End** identifies the end of the
item 2)

en executes a group of commands if
zero). **End** identifies the end of the
item 3)

ing and incrementing. It increments
to *end*, by *increment*. *increment* is
ified, 1 is used) and can be negative
a maximum or minimum value not to
entifies the end of the loop. **For(** loops
M CTL item 4)

*end,increment***)**
d not exceeded
d not exceeded

0,10,2):Disp A²:End, displays **0**, **4**, **16**,

While **While** performs a group of commands while *condition* is true. *condition* is frequently a relational test (Chapter 2). *condition* is tested when **While** is encountered. If *condition* is true (nonzero), the program executes a group of commands. **End** signifies the end of the group. If *condition* is false (zero), the program executes the commands following **End**. **While** instructions can be nested. (PRGM CTL item 5)

:While *condition*
:*command while condition is true*
:*command while condition is true*
:End
:*command*

Repeat **Repeat** repeats a group of commands until *condition* is true (nonzero). It is similar to **While**, but *condition* is tested when **End** is encountered; thus the group of commands will always be executed at least once. **Repeat** instructions can be nested. (PRGM CTL item 6)

:Repeat *condition*
:*command until condition is true*
:*command until condition is true*
:End
:*command*

End **End** identifies the end of a group of commands. Each **For**, **While**, **Repeat**, or **Else** loop must have an **End** at the "bottom," as must a **Then** loop without an associated **Else**. (PRGM CTL item 7)

Pause

Pause suspends execution of the program so you can see answers or graphs. During the pause, the dotted pause indicator displays. Press [ENTER] to resume execution. (PRGM CTL item 8)

- **Pause** with no *value* temporarily pauses the program. If the instruction **DispGraph** or **Disp** has been executed, then the appropriate screen is displayed.
- **Pause** *value* displays *value*, which can be scrolled, on the current Home screen.

Lbl
Goto

Lbl (label) and **Goto** (go to) are used together for branching.

Lbl specifies the *label* of a command. *label* is one character (A-Z, 0-9, or θ). (PRGM CTL item 9)

Lbl *label*

Goto causes the program to branch to *label* when the **Goto** is encountered. (PRGM CTL item 0)

Goto *label*

IS>(

IS>((increment-and-skip) adds 1 to *variable*; if the answer is greater than *value* (which can be an expression), the next command is skipped. *variable* cannot be a system variable. (PRGM CTL item A)

:IS>(*variable*,*value*)
:*command if variable* ≤ *value*
:*command if variable* > *value*

DS<(

DS<((decrement-and-skip) subtracts 1 from *variable*; if the answer is less than *value* (which can be an expression), the next command is skipped. *variable* cannot be a system variable. (PRGM CTL item B)

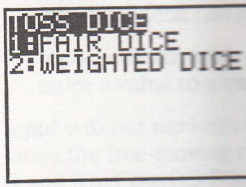
:DS<(*variable*,*value*)
:*command if variable* ≥ *value*
:*command if variable* < *value*

Menu(sets up branching encountered during exe displayed with the spec pause indicator displays menu selection is made.

The menu *title* is enclos pairs of menu items (*te* display as the menu sel branch if that selection

Menu("*title***","***text1***",***la*

For example, during ex **Menu("TOSS DICE","F DICE",B)** displays:



The program pauses u for example, the menu continues execution at

prgm is used to enter i programs as subroutin **prgm**, it is copied to th type the letters of a pr selecting existing prog but allows you to ente have not yet created. (

prgm*name*

Note: You cannot use (page 13-6).

ution of the program so you can see
ring the pause, the dotted pause
ss ENTER to resume execution.

ue temporarily pauses the program.
ispGraph or **Disp** has been
appropriate screen is displayed.

ys *value*, which can be scrolled, on
screen.

go to) are used together for

of a command. *label* is one character
M CTL item 9)

am to branch to *label* when the **Goto**
M CTL item 0)

ip) adds 1 to *variable*; if the answer
which can be an expression), the
ed. *variable* cannot be a system
tem A)

≤ *value*
> *value*

kip) subtracts 1 from *variable*; if
value (which can be an
ommand is skipped. *variable*
iable. (PRGM CTL item B)

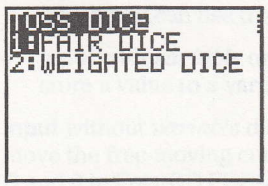
≥ *value*
< *value*

Menu(sets up branching within a program. If **Menu(** is encountered during execution, the menu screen is displayed with the specified menu items, the dotted-bar pause indicator displays, and execution pauses until a menu selection is made. (PRGM CTL item C)

The menu *title* is enclosed in ", followed by up to seven pairs of menu items (*text* enclosed between " marks to display as the menu selection and the *label* to which to branch if that selection is made).

Menu("*title***","***text1***",***label1***,"***text2***",***label2***, . . .)**

For example, during execution the instruction **Menu("TOSS DICE","FAIR DICE",A,"WEIGHTED DICE",B)** displays:



The program pauses until you select **1** or **2**. If you select **2**, for example, the menu disappears and the program continues execution at **Lbl B**.

prgm is used to enter instructions to execute other programs as subroutines (page 13-18). When you select **prgm**, it is copied to the cursor location. You may then type the letters of a program *name*. It is equivalent to selecting existing programs from the PRGM EXEC menu, but allows you to enter the name of a program that you have not yet created. (PRGM CTL item D)

prgm*name*

Note: You cannot use this command with RCL (page 13-6).

Return

Return quits the subroutine and returns to the calling program (page 13-18), even if encountered within nested loops. (Any loops are ended.) There is an implied **Return** at the end of any program called as a subroutine. Within the main program, it stops execution and returns to the Home screen. (PRGM CTL item E)

Stop

Stop stops execution of a program and returns you to the Home screen. (PRGM CTL item F)

The PRGM I/O (prog accessed only from PRGM ▸). They cont program during exe values and display

PRGM I/O Menu

```
CTL  I/O  EXEC
1:Input
2:Prompt
3:Disp
4:DispGraph
5:DispTable
6:Output(
7:getKey
8:ClrHome
9:ClrTable
0:PrintScreen
A:Get(
B:Send(
```

Input

- **Input** without *va* which you can u
- **Input** with *varia* store a value to

Displaying a Graph with Input

Input without *varia* move the free-movi **R** and θ in PolarGC indicator is displaye

Storing a Variable Value with Input

Input with *variable* may be a real numb value (which can be value is evaluated a resumes execution. enter " and then the the Y= function as e

Input *variable*

You can display a s prompt. Enter a val to *variable*, and the

Input "*string*",*vari*

utine and returns to the calling
even if encountered within nested
nded.) There is an implied Return
am called as a subroutine. Within
ops execution and returns to the
CTL item E)

f a program and returns you to the
CTL item F)

PRGM I/O (Input/Output) Instructions

The PRGM I/O (program input/output) instructions can be accessed only from within the program editor (press [PRGM] [▶]). They control input to and output from a program during execution. They allow you to enter values and display answers during program execution.

PRGM I/O Menu

```
CTL  I/O  EXEC
1: Input          Enter value or use free-moving cursor
2: Prompt         Prompt for entry of variable values
3: Disp           Display text, value, or Home screen
4: DispGraph      Display the current graph
5: DispTable      Display table
6: Output(        Display text at a specified position
7: getKey         Check the keyboard for a keystroke
8: ClrHome        Clear the display
9: ClrTable       Clear the current table
0: PrintScreen    Print the current screen
A: Get(           Gets variable from another device
B: Send(          Sends variable to another device
```

Input

- **Input** without *variable* is used to display a graph on which you can use the free-moving cursor.
- **Input** with *variable* or "*string*" and *variable* is used to store a value to a variable.

Displaying a Graph with Input

Input without *variable* displays the current graph. You can move the free-moving cursor, which updates **X** and **Y** (and **R** and θ in PolarGC FORMAT). The dotted-bar pause indicator is displayed. Press [ENTER] to resume execution.

Storing a Variable Value with Input

Input with *variable* prompts **?** during execution. *variable* may be a real number, list, matrix or Y= function. Enter a value (which can be an expression) and press [ENTER]. The value is evaluated and stored to *variable*, and the program resumes execution. If *variable* is **Y***n* or other Y= functions, enter " and then the expression, which will be stored to the Y= function as entered.

Input *variable*

You can display a *string* of up to 16 characters as a prompt. Enter a value and press [ENTER]. The value is stored to *variable*, and the program resumes execution.

Input "*string*",*variable*

Disp

- **Disp** (display) with no *value* displays the Home screen.
- **Disp** with one or more *values* displays text and values.

Displaying the Home Screen

Disp with no *value* displays the Home screen.

Disp

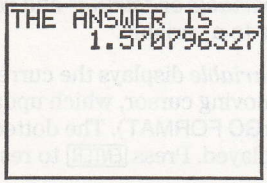
Displaying Values and Messages

Disp with one or more *values* displays the value of each.

Disp *valueA*,*valueB*

- If *value* is an expression, it is evaluated and then displayed on the right of the following line according to the current MODE settings.
- If *value* is text within " marks, it displays on the left of the current display line.

For example, **Disp "THE ANSWER IS",π/2** displays:



If **Pause** is encountered after **Disp**, the program halts temporarily so you can examine the screen. Press [ENTER] to resume execution.

Note: If a value or string is too large to display in its entirety, ... is displayed in the rightmost column, but the value cannot be scrolled. (To scroll the value, use **Pause** *value* instead.)

Prompt During execution **Pro** time, followed by =?. for each *variable*. Th resumes execution. (

Prompt *variableA*,*va*

For example, **Prompt** user to enter values f

If an expression is en expression is evaluat functions are not val

DispGraph **DispGraph** (display **Pause** is encountere temporarily so you c resume execution. (

DispTable **DispTable** (display t program halts tempo Press [ENTER] to resu item 5)

Output(**Output(** displays *tex* screen beginning at (1 through 16), typin may wish to precede Expressions are eva according to the cur displayed in entry fo (PRGM I/O item 6)

Output(*line*,*column* **Output(***line*,*column*

In **Split** screen MOD **Output(**.

with no *value* displays the Home screen.

r more *values* displays text and values.

displays the Home screen.

ore *values* displays the value of each.

pression, it is evaluated and then
right of the following line according to
E settings.

ithin " marks, it displays on the left of
ay line.

THE ANSWER IS",π/2 displays:

327

red after **Disp**, the program halts
n examine the screen. Press ENTER to

ing is too large to display in its
d in the rightmost column, but the
led. (To scroll the value, use

Prompt During execution **Prompt** displays each *variable*, one at a time, followed by **=?**. Enter a value and then press ENTER for each *variable*. The values are stored, and the program resumes execution. (PRGM I/O item 2)

Prompt *variableA*,*variableB*, . . .

For example, **Prompt Xmin, Xmax, Ymin, Ymax** allows the user to enter values for the viewing WINDOW.

If an expression is entered in response to **Prompt**, the expression is evaluated and then stored. **Y***n* and other Y= functions are not valid with **Prompt**.

DispGraph **DispGraph** (display graph) displays the current graph. If **Pause** is encountered after **DispGraph**, the program halts temporarily so you can examine the screen. Press ENTER to resume execution. (PRGM I/O item 4)

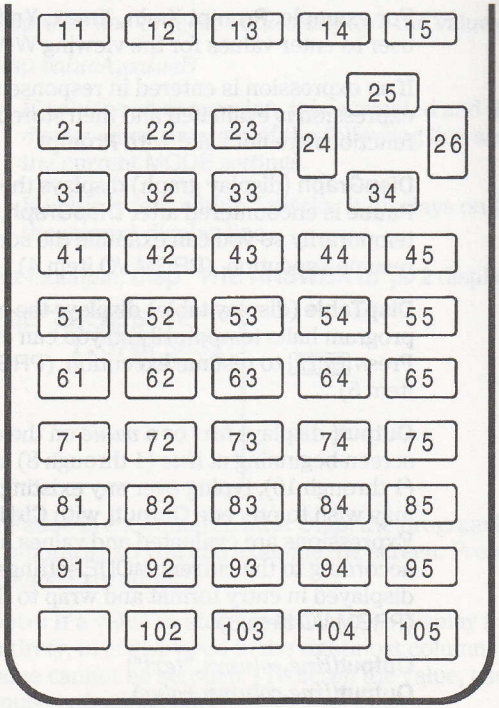
DispTable **DispTable** (display table) displays the current table. The program halts temporarily so you can examine the screen. Press ENTER to resume execution. (PRGM I/O item 5)

Output(**Output(** displays *text* or a *value* on the current Home screen beginning at *line* (1 through 8) and *column* (1 through 16), typing over any existing characters. You may wish to precede **Output(** with **ClrHome** (page 13-17). Expressions are evaluated and values are displayed according to the current MODE settings. Matrices are displayed in entry format and wrap to the next line. (PRGM I/O item 6)

Output(*line*,*column*,"*text*"**)**
Output(*line*,*column*,*value***)**

In **Split** screen MODE, the maximum value of *row* is 4 for **Output(**.

getKey **getKey** returns a number corresponding to the last key pressed, according to the diagram below. If no key has been pressed, it returns 0. **getKey** can be used inside loops to transfer control; for example, to create video games. (PRGM I/O item 7)



Note: You can press [ON] at any time to act as a break during execution (page 13-4).

ClrHome **ClrHome** (clear H during execution corner, but progra **Pause** is encounte

ClrTable **ClrTable** (clear ta during execution corner, but progra **Pause** is encounte

PrintScreen **PrintScreen** (prin printer attached t Macintosh® if you (Chapter 16). The Press [ENTER] to res **Pause** if you are item 0)

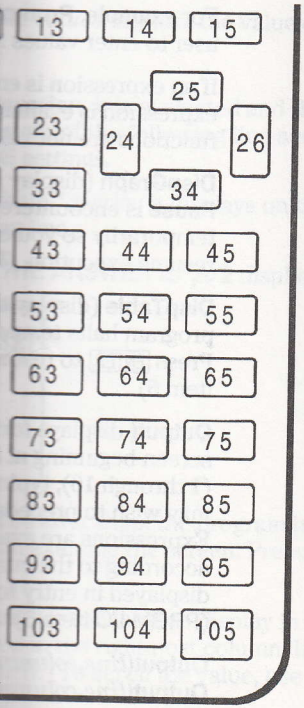
Get(**Get(** gets the cont stores it to *variab* be a number, list, Y= variable, graph used to get data f (PRGM I/O item A

Get(*variable*)

Send(**Send(** sends the c compatible devic TI-82. (PRGM I/O

Send(*variable*)

umber corresponding to the last key
to the diagram below. If no key has
urns 0. **getKey** can be used inside loops
for example, to create video games.



ON at any time to act as a break
ge 13-4).

ClrHome — **ClrHome** (clear Home screen) clears the Home screen during execution and places the cursor in the upper left corner, but program execution does not pause unless **Pause** is encountered. (PRGM I/O item 8)

ClrTable — **ClrTable** (clear table) clears the table in the table editor during execution and places the cursor in the upper left corner, but program execution does not pause unless **Pause** is encountered. (PRGM I/O item 9)

PrintScreen — **PrintScreen** (print screen) prints the current screen on a printer attached to an IBM®-compatible computer or a Macintosh® if you are using TI-GRAPH LINK™ software (Chapter 16). The dotted-bar pause indicator displays. Press ENTER to resume execution. **PrintScreen** acts like **Pause** if you are not using TI-GRAPH LINK. (PRGM I/O item 0)

Get(— **Get(** gets the contents of *variable* on another TI-82 and stores it to *variable* on the receiving TI-82. *variable* may be a number, list, list element, matrix, matrix element, Y= variable, graph database or picture. **Get(** also can be used to get data from an external compatible device. (PRGM I/O item A)

Get(*variable***)**

Send(— **Send(** sends the contents of *variable* to an external compatible device. It cannot be used to send to another TI-82. (PRGM I/O item B)

Send(*variable***)**

On the TI-82, any program can be called from another program as a subroutine. Enter the name of the program to use as a subroutine on a line by itself.

Calling a Program from Another Program

To call one program from another, begin on a blank line in the program editor and do one of the following:

- Press [PRGM] [◀] to display the PRGM EXEC menu and select the name of the program. **prgm** and the name are copied to the current cursor location.
- Select **prgm** from the PRGM CTL menu and type the letters of the program *name* (page 13-11).

prgm*name*

When this instruction is encountered during execution, the next command that the program executes is the first command in the second program. It returns to the subsequent command in the first program when it encounters either a **Return** instruction or the implied **Return** at the end.

```
PROGRAM:VOLCYL    ⇒ PROGRAM:AREACIRC
:Prompt D         ⇑ :D/2→R
:Prompt H         ⇑ :π*R²→A
:prgmAREACIRC ⇒   ⇑ :Return ⇒ ⇒ ⇒
 ⇒ :A*H→V                        ⇓
⇑  :Disp V                       ⇓
 ⇐ ⇐ ⇐ ⇐ ⇐ ⇐ ⇐ ⇐ ⇐ ⇐ ⇐ ⇐ ⇐ ⇐ ⇐
```

Notes about Calling Programs

Variables are global.

label used with **Goto** and **Lbl** is local to the program in which it is located. *label* in one program is not "known" by another program. You cannot use **Goto** to branch to a *label* in another program.

Return exits a subroutine and returns to the calling program, even if encountered within nested loops.

This chapter co incorporate featu chapters. Severa

Chapter Contents

Left-Brain, Right-
Speeding Tickets
Buying a Car, No
Graphing Inequal
Solving a System
Program: Sierpin
Cobweb Attracto
Program: Guess
The Unit Circle a
Ferris Wheel Pro
Reservoir Proble
Predator-Prey M
Fundamental Th
Finding the Area

Chapter 14: Applications

This chapter contains application examples that incorporate features described in the preceding chapters. Several of the examples use programs.

Chapter Contents

Left-Brain, Right-Brain Test Results	14-2
Speeding Tickets	14-4
Buying a Car, Now or Later?	14-5
Graphing Inequalities	14-6
Solving a System of Nonlinear Equations	14-7
Program: Sierpinski Triangle	14-8
Cobweb Attractors	14-9
Program: Guess the Coefficients	14-10
The Unit Circle and Trigonometric Curves	14-11
Ferris Wheel Problem	14-12
Reservoir Problem	14-14
Predator-Prey Model	14-16
Fundamental Theorem of Calculus	14-18
Finding the Area between Curves	14-20

Left-Brain, Right-Brain Test Results

An experiment found a significant difference between the ability of boys and girls to identify objects held in their left hands (which are controlled by the right side of the brain) versus their right hands (which are controlled by the left side of the brain). The TI Graphics team decided to conduct a similar test for adult men and women.

Problem

30 small objects were chosen. Coworkers held half of the objects (which they were not allowed to see) in their left hands and half in their right hands and tried to identify them. Use box plots to compare visually the results from the table below.

Correct Responses

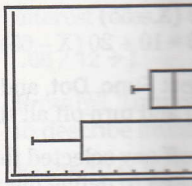
Women Left	Women Right	Men Left	Men Right
8	4	7	12
9	3	8	6
12	7	7	12
11	12	5	12
10	11	7	7
8	11	8	11
12	13	11	12
7	12	4	8
9	11	10	12
11	12	14	11
		13	9
		5	9

Procedure

1. Press [STAT] **1** (to select **Edit...**). If there are values in any of the lists, follow the procedure to clear lists described in Chapter 12. Enter the values for the number of correct guesses each woman made with her left hand in **L1**.
2. Press [▶] to move to **L2** and enter the scores that each woman made with her right hand.
3. Enter the men's scores in **L3** and **L4**.
4. Press [2nd] [STAT PLOT] **1** (to select **Plot1**). Turn on Plot1 and define it as a box plot, using **L1**. Press [2nd] [STAT PLOT] **2** (to select **Plot2**). Turn on Plot2 and define it as a box plot, using **L2**.
5. Press [Y=] and turn off any selected functions. Press [WINDOW]. Set **Xscl=1**, **Ymin=0**, **Yscl=0**. (Ignore the other WINDOW settings, which will be set by **ZoomStat**.)

Procedure (Continued)

6. Press [ZOOM] **9** (to viewing WINDOW women's results



7. Press [TRACE] and **maxX** for each pl hand? For the rig women guessed right hand?
8. Examine the men redefine Plot1 to [TRACE]. What diff
9. Compare the left- and redefine Plot [TRACE]. Were wo their left hands?
10. Compare the righ and redefine Plot [TRACE]. Were wo their right hands

The original expe as well with thei equally well with box plots showe because adults h sample was not

st Results

und a significant difference between the d girls to identify objects held in their are controlled by the right side of the r right hands (which are controlled by e brain). The TI Graphics team decided lar test for adult men and women.

ere chosen. Coworkers held half of the y were not allowed to see) in their left heir right hands and tried to identify ts to compare visually the results from

Correct Responses

Women Right	Men Left	Men Right
4	7	12
3	8	6
7	7	12
12	5	12
11	7	7
11	8	11
13	11	12
12	4	8
11	10	12
12	14	11
	13	9
	5	9

o select **Edit...**). If there are values in follow the procedure to clear lists apter 12. Enter the values for the ect guesses each woman made with her

e to **L2** and enter the scores that each ith her right hand.

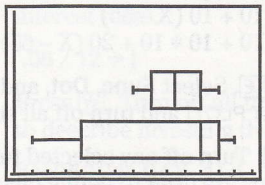
scores in **L3** and **L4**.

PLOT] **1** (to select **Plot1**). Turn on Plot1 a box plot, using **L1**. Press 2nd o select **Plot2**). Turn on Plot2 and x plot, using **L2**.

rn off any selected functions. Press **cl=1**, **Ymin=0**, **Yscl=0**. (Ignore the other gs, which will be set by **ZoomStat**.)

Procedure (Continued)

6. Press ZOOM **9** (to select **ZoomStat**). This adjusts the viewing WINDOW and displays the box plots for the women's results (left on top).



7. Press TRACE and examine **minX**, **Q1**, **Med**, **Q3**, and **maxX** for each plot. What is the median for the left hand? For the right hand? Does it appear that the women guessed correctly more often with the left or right hand?

8. Examine the men's results. Press 2nd [STAT PLOT] and redefine Plot1 to use **L3** and Plot2 to use **L4**. Press TRACE. What difference do you see between the plots?

9. Compare the left-hand results. Press 2nd [STAT PLOT] and redefine Plot1 to use **L1** and Plot2 to use **L3**. Press TRACE. Were women or men better at guessing with their left hands?

10. Compare the right-hand results. Press 2nd [STAT PLOT] and redefine Plot1 to use **L2** and Plot2 to use **L4**. Press TRACE. Were women or men better at guessing with their right hands?

    The original experiment found that boys did not guess as well with their right hands, while girls guessed equally well with either hand. That is not what these box plots showed for adults. Do you think that this is because adults have learned to adapt or because our sample was not large enough?

Speeding Tickets

The fine for speeding in your area is $50 plus $5 per mile per hour over the limit for the first 10 miles, plus $10 per mile per hour for the next 10 miles, plus $20 per mile thereafter. Graph the piecewise function that describes the cost of the ticket in a 45-mile-per-hour zone.

Problem

The fine (**Y**) as a function of miles per hour (**X**) is:

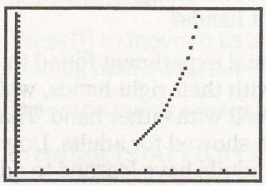
$$\begin{aligned} Y &= 0 && 0 < X \le 45 \\ Y &= 50 + 5\,(X - 45) && 45 < X \le 55 \\ Y &= 50 + 5 * 10 + 10\,(X - 55) && 55 < X \le 65 \\ Y &= 50 + 5 * 10 + 10 * 10 + 20\,(X - 65) && 65 < X \end{aligned}$$

Procedure

1. Press [MODE]. Select **Func**, **Dot**, and the defaults. Press [2nd] [STAT PLOT] and turn off all stat plots.
2. Press [Y=]. Turn off any selected functions. The TEST operations are used to define piecewise functions. Enter the Y= function to describe the fine.

   Y1=(50+5(X–45))(45<X)(X≤55)
   +(100+10(X–55))(55<X)(X≤65)
   +(200+20(X–65))(65<X)

3. Press [WINDOW] and set **Xmin = -2**, **Xscl = 10**, **Ymin = -5**, and **Yscl = 10**. Ignore **Xmax** and **Ymax**. (They are set by **ΔX** and **ΔY** in step 4.)
4. Press [2nd] [QUIT] to return to the Home screen and store **1** to **ΔX** and **5** to **ΔY**. (**ΔX** and **ΔY**, the distance between the centers of adjacent pixels, are on the VARS Window... menu.) Defining **ΔX** and **ΔY** as integers produces nice values for TRACE.
5. Press [TRACE] to plot the functions. At what speed does the ticket exceed $250?



Buying a Car, Now or Later?

You have identified costs $8,000. You c month. You can eith interest (compound invest the payments How long will it take

Procedure

1. Press [MODE]. Sele [2nd] [STAT PLOT]
2. On the Home scr interest rates.

   .06 / 12 → I

3. Press [Y=]. Turn o to describe inves

   Y2=250((1+I)^X

4. Enter the formul

   Y3=8000–250(1

5. To determine ho cash, press [2nd] Solve the equati using 36 months MATH menu.)

   solve(Y2–8000,

6. To determine ho enter:

   solve(Y3,X,36)

7. To calculate hov got a loan, press to pay off the lo
8. Press [2nd] [TABL the amount still
9. Press [WINDOW]. S

   Xmin = 0
   Xmax = 47
   Xscl = 12

10. Press [TRACE] to

eeding in your area is $50 plus $5 per mile
he limit for the first 10 miles, plus $10 per
or the next 10 miles, plus $20 per mile
ph the piecewise function that describes
ticket in a 45-mile-per-hour zone.

a function of miles per hour (**X**) is:

	$0 < X \leq 45$
45)	$45 < X \leq 55$
+ 10 (X – 55)	$55 < X \leq 65$
+ 10 * 10 + 20 (X – 65)	$65 < X$

Select **Func**, **Dot**, and the defaults. Press
LOT] and turn off all stat plots.

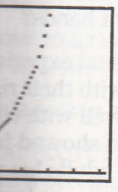
rn off any selected functions. The TEST
re used to define piecewise functions.
function to describe the fine.

–45))(45<X)(X≤55)
(X–55))(55<X)(X≤65)
(X–65))(65<X)

] and set **Xmin = -2**, **Xscl = 10**, **Ymin = -5**,
0. Ignore **Xmax** and **Ymax**. (They are set by
step 4.)

UIT] to return to the Home screen and
and **5** to **ΔY**. (**ΔX** and **ΔY**, the distance
centers of adjacent pixels, are on the
W... menu.) Defining **ΔX** and **ΔY** as integers
e values for TRACE.

to plot the functions. At what speed does
eed $250?



Buying a Car, Now or Later?

You have identified the car you would like to buy, which costs $8,000. You can afford payments of $250 per month. You can either borrow the money at 10% annual interest (compounded monthly) and buy the car now, or invest the payments at 6% and pay cash for the car later. How long will it take to pay for the car each way?

Procedure

1. Press [MODE]. Select the default MODE settings. Press [2nd] [STAT PLOT] and turn off all stat plots.
2. On the Home screen, store the values of the periodic interest rates.

   .06 / 12 → I **.10 / 12 → J**
3. Press [Y=]. Turn off all functions and enter the formula to describe investing the money.

   Y_2=250((1+I)^X–1)/I
4. Enter the formula to describe making car payments.

   Y_3=8000–250(1–(1+J)^–X)/J
5. To determine how many months will be required to pay cash, press [2nd] [QUIT] to return to the Home screen. Solve the equation (the amount saved less $8000) for **X**, using 36 months as the guess. (**solve(** is on the MATH MATH menu.)

   solve(Y_2–8000,X,36)
6. To determine how long it will take to pay off the loan, enter:

   solve(Y_3,X,36)
7. To calculate how much you would pay in total if you got a loan, press [×] **250**, which multiplies the months to pay off the loan (in **Ans**) by the payment amount.
8. Press [2nd] [TABLE] to examine the amount saved versus the amount still owed for each time period.
9. Press [WINDOW]. Set the viewing WINDOW.

   Xmin = 0 **Ymin = 0**
   Xmax = 47 **Ymax = 8000**
   Xscl = 12 **Yscl = 1000**
10. Press [TRACE] to examine the amounts graphically.

Graphing Inequalities

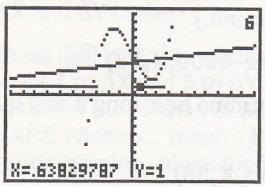
Examine the inequality .4X³–3X+5<.2X+4 graphically. Use the TEST functions to explore the values of X where the inequality is true and where it is false.

Procedure

1. Press [MODE]. Select **Dot**, **Simul**, and the default MODE settings. Press [2nd] [STAT PLOT] and turn off all stat plots.
2. Press [Y=]. Turn off all functions. Enter the left side of the inequality as **Y4** and the right side as **Y5**.

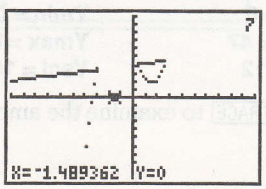
   Y4=.4X³–3X+5
   Y5=.2X+4
3. Enter the statement of the inequality as **Y6**. This function evaluates to 1 if true and 0 if false.

   Y6=Y4<Y5
4. Press [ZOOM] **6** to graph the inequality in the standard WINDOW.
5. Press [TRACE] [▼] [▼] to move to **Y6** and trace the inequality, observing the value of **Y**.



6. Press [Y=]. Turn off **Y4**, **Y5**, and **Y6**. Enter equations to graph only the inequality.

   Y7=Y6Y4
   Y8=Y6Y5
7. Press [TRACE]. Notice that the values of **Y7** and **Y8** are zero where the inequality is false.

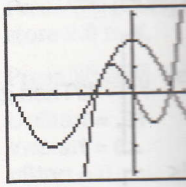


Solving a System of Nonline

Solve the equation X another way, solve t unknowns: Y=X³–2X to control the decim

Procedure

1. Press [MODE]. Selec [2nd] [STAT PLOT] a Turn off all functi **Y7=X³–2X** and **Y8**
2. Press [ZOOM] and s that there are two (points where the



3. Press [ZOOM] [▶] ar MEMORY menu.
4. Press [ZOOM] **2** (to to position the fi intersection of th display. As you m coordinates have
5. Press [ENTER] to z intersection. As the **X** and **Y** coor
6. Press [ENTER] to z cursor to a point number of decim
7. Press [2nd] [CALC select the First c curve. Now trace press [ENTER]. Wh intersection?
8. Press [ZOOM] and original graph.
9. Press [ZOOM]. Sel other apparent i

lity .4X3–3X+5<.2X+4 graphically. Use
to explore the values of X where the
d where it is false.

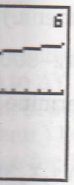
ct **Dot**, **Simul**, and the default MODE
nd [STAT PLOT] and turn off all stat

ff all functions. Enter the left side of
Y4 and the right side as **Y5**.

ent of the inequality as **Y6**. This
s to 1 if true and 0 if false.

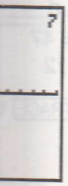
graph the inequality in the standard

] to move to **Y6** and trace the
ing the value of **Y**.



f **Y4**, **Y5**, and **Y6**. Enter equations to
quality.

ce that the values of **Y7** and **Y8** are
equality is false.

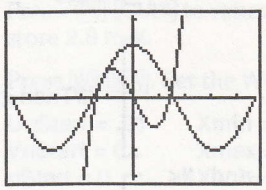


Solving a System of Nonlinear Equations

Solve the equation $X^3-2X=2\cos X$ graphically. Stated another way, solve the system of two equations and two unknowns: $Y=X^3-2X$ and $Y=2\cos X$. Use the ZOOM factors to control the decimal places displayed on the graph.

Procedure

1. Press [MODE]. Select the default MODE settings. Press [2nd] [STAT PLOT] and turn off all stat plots. Press [Y=]. Turn off all functions and enter the functions **$Y_7=X^3-2X$** and **$Y_8=2\cos X$**.
2. Press [ZOOM] and select **ZDecimal**. The display shows that there are two areas that might contain solutions (points where the two functions appear to intersect).



3. Press [ZOOM] [▶] and select **SetFactors...** from the ZOOM MEMORY menu. Set **XFact=10** and **YFact=10**.
4. Press [ZOOM] **2** (to select **Zoom In**). Use [▶], [◀], [▲], and [▼] to position the free-moving cursor on the apparent intersection of the functions on the right side of the display. As you move the cursor, note that the **X** and **Y** coordinates have one decimal place.
5. Press [ENTER] to zoom in. Move the cursor over the intersection. As you move the cursor, note that now the **X** and **Y** coordinates have two decimal places.
6. Press [ENTER] to zoom in again. Move the free-moving cursor to a point exactly on the intersection. Note the number of decimal places.
7. Press [2nd] [CALC] and select **intersect**. Press [ENTER] to select the First curve and [ENTER] to select the Second curve. Now trace to a Guess near the intersection and press [ENTER]. What are the coordinates of the intersection?
8. Press [ZOOM] and select **ZDecimal** to redisplay the original graph.
9. Press [ZOOM]. Select **Zoom In** and explore as above the other apparent intersection.

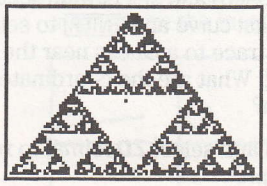
Program: Sierpinski Triangle

This program creates a drawing of a famous fractal, the Sierpinski Triangle, and stores the drawing in a picture.

Program

```
PROGRAM:SIERPINS
:FnOff :ClrDraw
:PlotsOff
:AxesOff
:0→Xmin:1→Xmax          ┐ Set viewing WINDOW
:0→Ymin:1→Ymax          ┘
:rand→X:rand→Y
:For(K,1,3000)          ┐ Beginning of For group
:rand→N
:If N≤1/3               ┐
:Then                   │
:.5X→X                  │ If/Then group
:.5Y→Y                  │
:End                    ┘
:If 1/3<N and N≤
2/3                     ┐
:Then                   │ If/Then group
:.5(.5+X)→X             │
:.5(1+Y)→Y              │
:End                    ┘
:If 2/3<N               ┐
:Then                   │ If/Then group
:.5(1+X)→X              │
:.5Y→Y                  │
:End                    ┘
:Pt-On(X,Y)             ┐ Draw point
:End                    ┘ End of For group
:StorePic Pic6
```

Note: After executing this program, you can recall and display the picture with the instruction **RecallPic Pic6**.



Cobweb Attractors

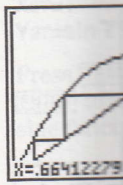
Using Web WIN with attracting graphing.

Procedure

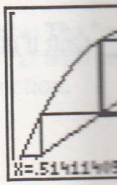
1. Press MODE. FORMAT a turn off all
2. Press Y=. E keyboard.)

   Un=K Un-1
3. Press 2nd store **2.9** to
4. Press WINDO

   UnStart = .
   VnStart = 0
   nStart = 0
   nMin = 0
   nMax = 10
5. Press TRACE trace the c



6. Change K two attract
7. Change K four attrac



s a drawing of a famous fractal, the
nd stores the drawing in a picture.

Set viewing WINDOW

Beginning of **For** group

If/Then group

If/Then group

If/Then group

Draw point

End of **For** group

his program, you can recall and
the instruction **RecallPic Pic6**.

Cobweb Attractors

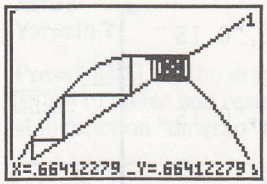
Using Web WINDOW FORMAT, you can identify points with attracting and repelling behavior in sequence graphing.

Procedure

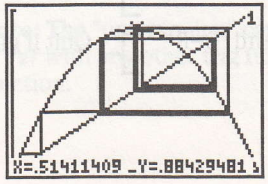
1. Press [MODE]. Select **Seq**. Press [WINDOW] [▶]. Select **Web** FORMAT and the defaults. Press [2nd] [STAT PLOT] and turn off all stat plots.
2. Press [Y=]. Enter the sequence. (**U*n*-1** is on the keyboard.)

   U*n*=K U*n*-1 (1–U*n*-1)
3. Press [2nd] [QUIT] to return to the Home screen and store **2.9** to **K**.
4. Press [WINDOW]. Set the WINDOW variables.

U*n*Start = .01	**Xmin = 0**	**Ymin = 0**
V*n*Start = 0	**Xmax = 1**	**Ymax = 1**
***n*Start = 0**	**Xscl = 1**	**Yscl = 1**
***n*Min = 0**		
***n*Max = 10**		
5. Press [TRACE] to display the graph, and then press [▶] to trace the cobweb. This is a cobweb with one attractor.



6. Change **K** to **3.44** and TRACE to show a cobweb with two attractors.
7. Change **K** to **3.54** and TRACE to show a cobweb with four attractors.



Program: Guess the Coefficients

This program graphs the function A sin BX with random integer coefficients between 1 and 10. You then try to guess the coefficients and graph your guess as C sin DX. The program continues until your guess is correct.

Program

```
PROGRAM:GUESS
:PlotsOff :Func
:FnOff :Radian
:ClrHome
:"Asin BX"→Y1
:"Csin DX"→Y2
:iPart 10rand+1→
A
:iPart 10rand+1→
B
:0→C:0→D
:-2π→Xmin
:2π→Xmax
:π/2→Xscl
:-10→Ymin
:10→Ymax
:1→Yscl
:DispGraph
:Lbl Z
:Prompt C,D
:If C=A
:Text(1,1,"C IS
OK")
:If C≠A
:Text(1,1,"C IS
WRONG")
:If D=B
:Text(1,50,"D IS
 OK")
:If D≠B
:Text(1,50,"D IS
 WRONG")
:DispGraph
:Pause
:If C=A and D=B
:Stop
:Goto Z
```

Define equations

Initialize coefficients

Set viewing WINDOW

Display graph

Prompt for guess

Display results

Quit if guesses are correct

The Unit Circle and Trig

You can use th to show the re trigonometric

Problem

Graph the unit graphically the

Any function th be plotted in pa component as

Solution

1. Press MODE.
2. Press WINDO

   Tmin = 0
   Tmax = 2π
   Tstep = .1

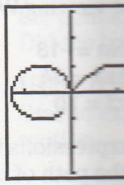
3. Press Y=. T expressions

   X1T=cos T-
   Y1T=sin T

4. Enter the e

   X2T=T
   Y2T=sin T

5. Press TRAC ENTER to pa sine functi



Note: The "un in Y2T with any function.

the function A sin BX with random
etween 1 and 10. You then try to
s and graph your guess as C sin DX.
es until your guess is correct.

Define equations

Initialize coefficients

Set viewing WINDOW

Display graph

Prompt for guess

Display results

Quit if guesses are correct

The Unit Circle and Trigonometric Curves

You can use the parametric graphing feature of the TI-82 to show the relationship between the unit circle and any trigonometric curve.

Problem

Graph the unit circle and the sine curve to demonstrate graphically the relationship between them.

Any function that can be plotted in function graphing can be plotted in parametric graphing by defining the **X** component as **T** and the **Y** component as F(**T**).

Solution

1. Press [MODE]. Select **Radian**, **Par**, and **Simul**.
2. Press [WINDOW]. Set the viewing WINDOW.

Tmin = 0	**Xmin = -2**	**Ymin = -3**
Tmax = 2π	**Xmax = 2π**	**Ymax = 3**
Tstep = .1	**Xscl = π/2**	**Yscl = 1**

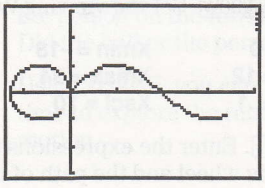
3. Press [Y=]. Turn off all selected functions. Enter the expressions to define the unit circle centered at (-1,0).

   X1T=cos T−1
   Y1T=sin T

4. Enter the expressions to define the sine curve.

   X2T=T
   Y2T=sin T

5. Press [TRACE]. As the graph is plotting, you may press [ENTER] to pause and resume graphing as you watch the sine function "unwrap" from the unit circle.



Note: The "unwrapping" can be generalized. Replace **sin T** in **Y2T** with any other trig function to "unwrap" that function.

Ferris Wheel Problem

Use two pairs of parametric equations to describe two objects in motion, a person on a ferris wheel and a ball thrown to that person. Determine when the two objects are closest.

Problem

The ferris wheel has a diameter of 20 meters (d) and is rotating counterclockwise at a rate of one revolution every 12 seconds (s). The following parametric equation describes the location of the person on the ferris wheel at time T, where α is the angle of rotation, the bottom center of the ferris wheel is (0,0), and the passenger is at the rightmost point (10,10) when T = 0.

$X(T) = r \cos \alpha$ where $\alpha = 2\pi T / s$ and $r = d / 2$
$Y(T) = r + r \sin \alpha$

The ball is thrown from a height even with the bottom of the ferris wheel, but 25 meters (b) to the right of the bottom center of the ferris wheel (25,0), with velocity (v_0) of 22 meters per second at an angle (θ) of 66° from the horizontal. The following parametric equation describes the location of the ball at time T.

$X(T) = b - T\, v_0 \cos \theta$
$Y(T) = T\, v_0 \sin \theta - (g/2)\, T^2$ $\quad (g = 9.8 \text{ m/sec}^2)$

Solution

1. Press [MODE]. Select **Par**, **Connected**, and **Simul**. Simultaneous MODE simulates what is happening with the two objects in motion over time.
2. Press [Y=] and turn off all functions. Press [2nd] [STAT PLOT] and turn off all stat plots.
3. Press [WINDOW]. Set the viewing WINDOW.

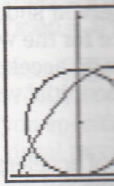
Tmin = 0	**Xmin = -13**	**Ymin = 0**
Tmax = 12	**Xmax = 34**	**Ymax = 31**
Tstep = .1	**Xscl = 10**	**Yscl = 10**

4. Press [Y=]. Enter the expressions to define the path of the ferris wheel and the path of the ball.

X_{1T}=10cos (πT/6)
Y_{1T}=10+10sin (πT/6)
X_{2T}=25–22Tcos 66°
Y_{2T}=22Tsin 66°–(9.8/2)T^2

Solution (Continued)

5. Press [GRAP
as they are
passenger
where the
the ferris



6. Press [WIND
concentra

Tmin = 1
Tmax = 3
Tstep = .0

7. Press [TRA
move nea
paths cro
8. Press [▼] t
values of
cursor is
the perso
Did the b

Using TR
time to e
motion.

metric equations to describe two
erson on a ferris wheel and a ball
. Determine when the two objects

diameter of 20 meters (d) and is
wise at a rate of one revolution every
llowing parametric equation
of the person on the ferris wheel at
angle of rotation, the bottom center
0,0), and the passenger is at the
) when T = 0.

re $\alpha = 2\pi T / s$ and $r = d / 2$

n a height even with the bottom of
5 meters (b) to the right of the
rris wheel (25,0), with velocity (v_0)
d at an angle (θ) of 66° from the
ng parametric equation describes
at time T.

2) T^2 ($g = 9.8$ m/sec^2)

Par, **Connected**, and **Simul**.
E simulates what is happening with
motion over time.

off all functions. Press 2nd
rn off all stat plots.

he viewing WINDOW.

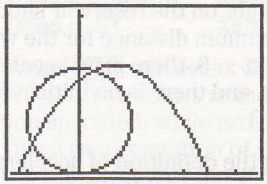
Xmin = -13	Ymin = 0
Xmax = 34	Ymax = 31
Xscl = 10	Yscl = 10

expressions to define the path of
d the path of the ball.

/6)
6°
9.8/2)T^2

Solution (Continued)

5. Press GRAPH to graph the equations and watch closely as they are plotted. Notice that the ball and the passenger on the ferris wheel appear to be closest near where the paths cross in the upper right quadrant of the ferris wheel.



6. Press WINDOW. Change the viewing WINDOW to concentrate on this portion of the graph.

Tmin = 1	**Xmin = 0**	**Ymin = 10**
Tmax = 3	**Xmax = 23.5**	**Ymax = 25.5**
Tstep = .03	**Xscl = 10**	**Yscl = 10**

7. Press TRACE. After the graph is plotted, press ▶ to move near the point on the ferris wheel where the paths cross. Note the values of **X**, **Y**, and **T**.

8. Press ▼ to move to the curve of the ball. Note the values of **X** and **Y** (**T** is unchanged). Notice where the cursor is located. This is the position of the ball when the person on the ferris wheel passes the intersection. Did the ball or the person reach the intersection first?

   Using TRACE, you can, in effect, take "snapshots" in time to explore the relative behavior of two objects in motion.

Reservoir Problem

On the TI-82, parametric graphing can be used to animate a process, providing valuable insight into dynamic problems such as water flow out of a reservoir.

Problem

A new park has a series of waterfalls, fountains, and pools (reservoirs). The height of one of the reservoirs is 2 meters. Several holes of relatively small diameter will be drilled in the side to make streams of water that fall into the next pool.

At what height on the reservoir should a hole be placed to get the maximum distance for the water jet? (Assume that the hole is at x=0, there is no acceleration in the x-direction, and there is no initial velocity in the y-direction.)

Integrating the definition of acceleration in both the x and y directions twice yields the equations $x=v_0t$ and $y=h_0-(g/2)t^2$. Solving Bernoulli's equation for v_0 and substituting into v_0t, we get the parametric equations

$$xt = t\sqrt{(2\,g\,(2-h_0))}$$
$$yt = h_0 - (g/2)\,t^2$$

where t is the time in seconds, h_0 is the height of the hole in the reservoir in meters, and g is the gravitational constant (9.8 meters/sec^2).

Procedure

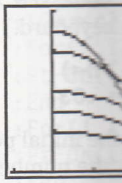
1. Press [MODE]. Select **Par**, **Simul**, and the defaults.
2. Press [Y=] and [CLEAR] all functions. Enter the equations to plot the water jet for a hole at height **0.5** meters.

   X1T=T√(2*9.8(2–0.50))
   Y1T=0.50–(9.8/2)T²
3. Press [ENTER] to move to **X2T**. Press [2nd] [RCL] [2nd] [Y-VARS] **2** (to display the **Parametric...** menu) **1** (to select **X1T**) [ENTER]. This recalls the contents of **X1T** into **X2T**. Change the height from **0.50** to **0.75** meters. Repeat the process to recall **Y1T** into **Y2T** and edit it.

Procedure (Continued)

4. Repeat step using the h
5. Press [WINDO

   Tmin = 0
   Tmax = √(4
   Tstep = .01
6. Press [ZOOM WINDOW v you specifi visual repr the trajecto heights. Wh distance fo



7. Use TRACE reservoir w
8. Where wou fountain th
9. Can you th show two

etric graphing can be used to
providing valuable insight into
uch as water flow out of a reservoir.

es of waterfalls, fountains, and pools
ght of one of the reservoirs is
es of relatively small diameter will be
nake streams of water that fall into

reservoir should a hole be placed to
ance for the water jet? (Assume that
re is no acceleration in the
is no initial velocity in the

ion of acceleration in both the x and
lds the equations $x=v_0t$ and
Bernoulli's equation for v_0 and
ve get the parametric equations

seconds, h_0 is the height of the hole
ers, and g is the gravitational
ec^2).

Par, **Simul**, and the defaults.

R] all functions. Enter the equations
t for a hole at height **0.5** meters.

0.50))
T^2

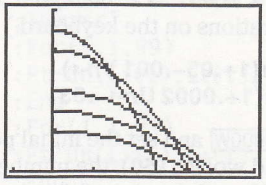
ve to **X2T**. Press [2nd] [RCL] [2nd]
lay the **Parametric...** menu) **1** (to
This recalls the contents of **X1T** into
ight from **0.50** to **0.75** meters.
s to recall **Y1T** into **Y2T** and edit it.

Procedure (Continued)

4. Repeat step 3 to create three more pairs of equations using the heights **1.00**, **1.50**, and **1.75** meters.
5. Press [WINDOW]. Set the viewing WINDOW.

Tmin = 0	**Xmin = 0**	**Ymin = 0**
Tmax = √(4/9.8)	**Xmax = 2**	**Ymax = 2**
Tstep = .01	**Xscl = .5**	**Yscl = .5**

6. Press [ZOOM] and select **ZSquare**. **ZSquare** adjusts the WINDOW variables to include the viewing WINDOW you specified, while providing a realistic (proportional) visual representation of the water jets. It then graphs the trajectories of the water jets from the 5 chosen heights. What height seems to provide the maximum distance for the water jet?



7. Use TRACE to determine the distance from the reservoir where each water jet hits the next pool.
8. Where would you place the holes to construct a fountain that you find visually interesting?
9. Can you think of a way to construct the problem to show two levels of fountains?

Predator-Prey Model

Use sequence graphing on the TI-82 to explore the well-known predator-prey model in biology. Determine the numbers of rabbits and wolves that maintain population equilibrium in a certain region.

Problem

R = Number of rabbits.
M = Growth rate of rabbits if there are no wolves.
K = Rate at which wolves can kill rabbits.
W = Number of wolves.
G = Growth rate of wolves if there are rabbits.
D = Death rate of wolves if there are no rabbits.

$R_n = R_{n-1}\ (1 + M - K\,W_{n-1})$
$W_n = W_{n-1}\ (1 + G\,R_{n-1} - D)$

Procedure

1. Press [MODE]. Select **Seq** and the defaults. Press [WINDOW] [▶]. Select **Time** FORMAT and the defaults. Press [2nd] [STAT PLOT] and turn off all stat plots.

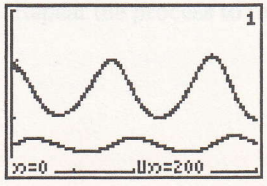
2. Press [Y=]. Enter functions to describe the number of rabbits (**U*n***) and the number of wolves (**V*n***) for **M = .05**, **K = .001**, **G = .0002**, **D = .03**. (**V*n*-1** and **U*n*-1** are 2nd operations on the keyboard.)

   U*n*=U*n*-1(1+.05−.001 V*n*-1)
   V*n*=V*n*-1(1+.0002 U*n*-1−.03)

3. Press [WINDOW] and set the initial population of rabbits (**200**) and wolves (**50**), the number of time periods to plot (**400**), and the size of the viewing WINDOW.

U*n*start = 200	**Xmin = 0**	**Ymin = 0**
V*n*start = 50	**Xmax = 400**	**Ymax = 300**
***n*Start = 0**	**Xscl = 100**	**Yscl = 100**
***n*Min = 0**		
***n*Max = 400**		

4. Press [TRACE] to plot and explore the number of rabbits (**U*n***) and wolves (**V*n***) over time (***n***). Determine the maximum and minimum number of each.

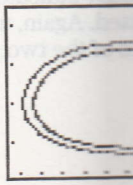


Procedure (Continued)

5. Enter the prog

```
PROGRAM:ORB
:ClrDraw:Fn
:PlotsOff :
:Un(1,99,1)
:Vn(1,99,1)
:Un(100,198
:Vn(100,198
:Un(199,297
:Vn(199,297
:min(L1)-10
:max(L1)+10
:10→Xscl
:min(L2)-10
:max(L2)+10
:10→Yscl
:For(I,1,99
:Pt-On(L1(I
:End
:For(I,1,99
:Pt-On(L3(I
:End
:For(I,1,99
:Pt-On(L5(I
:End
```

6. Execute prgm
numbers of ra
297 periods. U
number of rab



ng on the TI-82 to explore the well-
model in biology. Determine the
nd wolves that maintain population
in region.

its.
abbits if there are no wolves.
olves can kill rabbits.
es.
volves if there are rabbits.
lves if there are no rabbits.

W_{n-1})
– D)

Seq and the defaults. Press [WINDOW]
RMAT and the defaults. Press [2nd]
rn off all stat plots.

ctions to describe the number of
e number of wolves (**V***n*) for
= .0002, **D = .03**. (**V***n*-1 and **U***n*-1 are
he keyboard.)

01 V*n*-1)
U*n*-1–.03)

et the initial population of rabbits
50), the number of time periods to
size of the viewing WINDOW.

min = 0	Ymin = 0
max = 400	Ymax = 300
scl = 100	Yscl = 100

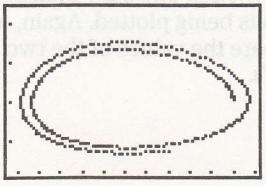
and explore the number of rabbits
n) over time (*n*). Determine the
mum number of each.

Procedure (Continued)

5. Enter the program:

```
PROGRAM:ORBIT
:ClrDraw:FnOff
:PlotsOff :Dot
:Un(1,99,1)→L1
:Vn(1,99,1)→L2
:Un(100,198,1)→L3
:Vn(100,198,1)→L4
:Un(199,297,1)→L5
:Vn(199,297,1)→L6
:min(L1)-10→Xmin
:max(L1)+10→Xmax
:10→Xscl
:min(L2)-10→Ymin
:max(L2)+10→Ymax
:10→Yscl
:For(I,1,99)
:Pt-On(L1(I),L2(I))
:End
:For(I,1,99)
:Pt-On(L3(I),L4(I))
:End
:For(I,1,99)
:Pt-On(L5(I),L6(I))
:End
```

6. Execute **prgmORBIT**, which shows the cycle of the numbers of rabbits (X axis) and wolves (Y axis) over 297 periods. Use the free-moving cursor to explore the number of rabbits and wolves.



Fundamental Theorem of Calculus

The TI-82 can graph functions that are defined by integrals or derivatives, using the functions fnInt(and nDeriv(from the MATH MATH menu.

Problem 1

Demonstrate graphically that

$$F(x) = \int_1^x 1/t\,dt = \ln(x),\ x>0 \text{ and that}$$

$$D_x\left[\int_1^x 1/t\,dt\right] = 1/x$$

Procedure 1

1. Press [MODE]. Select **Simul** and the default MODE settings. Press [Y=] and turn off all functions. Press [2nd] [STAT PLOT] and turn off all stat plots.
2. Press [WINDOW]. Set the viewing WINDOW.

   Xmin = .01 **Ymin = -1.5**
   Xmax = 10 **Ymax = 2.5**
   Xscl = 1 **Yscl = 1**
3. Press [Y=]. Enter the numerical integral of 1/T and the mathematical integral of 1/X.

   Y1=fnInt(1/T,T,1,X)
   Y2=ln X
4. Press [TRACE]. The busy indicator displays while the graph is being plotted. Use the cursor keys to compare the values of **Y1** and **Y2**.
5. Press [Y=]. Turn off **Y1** and **Y2**, and then enter the numerical derivative of the integral of 1/X and the function 1/X.

   Y3=nDeriv(Y1,X,X)
   Y4=1/X
6. Press [TRACE]. The busy indicator displays while the graph is being plotted. Again, use the cursor keys to compare the values of the two graphed functions, **Y3** and **Y4**.

Problem 2

Explore the functi

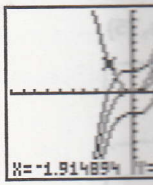
$$y = \int_{-2}^x t^2\,dt, \int_0^x t^$$

Procedure 2

1. Press [Y=]. Turn functions abo list.

   Y5=fnInt(T²,T,
2. Press [MODE]. Se
3. Press [ZOOM] 6
4. Press [TRACE]. identical, but
5. Press [Y=]. Ente

   Y6=nDeriv(Y5,
6. Press [TRACE]. defined by **Y5** derivative.



ph functions that are defined by
atives, using the functions fnInt(and
MATH MATH menu.

nically that

ln(x), x>0 and that

1/x

ect **Simul** and the default MODE
Y= and turn off all functions. Press 2nd
d turn off all stat plots.

Set the viewing WINDOW.

Ymin = -1.5
Ymax = 2.5
Yscl = 1

the numerical integral of 1/T and the
ntegral of 1/X.

1,X)

e busy indicator displays while the
lotted. Use the cursor keys to compare
and Y_2.

off Y_1 and Y_2, and then enter the
ative of the integral of 1/X and the

,X)

e busy indicator displays while the
lotted. Again, use the cursor keys to
ues of the two graphed functions, Y_3

Problem 2

Explore the functions defined by

$$y = \int_{-2}^{x} t^2\,dt, \int_{0}^{x} t^2\,dt, \text{ and } \int_{2}^{x} t^2\,dt$$

Procedure 2

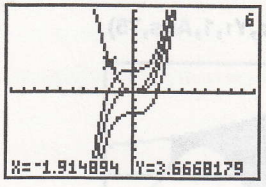
1. Press Y=. Turn off all functions. On the TI-82, the three functions above can be defined simultaneously using a list.

   Y_5=fnInt(T^2,T,{-2,0,2},X)

2. Press MODE. Select **Sequential**.
3. Press ZOOM **6** to select **ZStandard**.
4. Press TRACE. Notice that the functions appear identical, but shifted vertically by a constant.
5. Press Y=. Enter the numerical derivative of **Y_5**.

   Y_6=nDeriv(Y_5,X,X)

6. Press TRACE. Notice that although the three graphs defined by **Y_5** are unique, they share the same derivative.



Finding the Area between Curves

Find the area of the region bounded by
$f(x) = 300\,x / (x^2 + 625)$
$g(x) = 3 \cos .1\,x$
$x = 75$

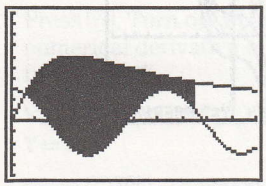
Procedure

1. Press [MODE]. Select the default MODE settings. Press [2nd] and turn off all functions. Press [2nd] [STAT PLOT] and turn off all stat plots.
2. Press [WINDOW]. Set the viewing WINDOW.

   Xmin = 0 **Ymin = -5**
   Xmax = 100 **Ymax = 10**
   Xscl = 10 **Yscl = 1**
3. Press [Y=]. Enter the upper and lower functions.

   Y_1=300X/(X^2+625)
   Y_2=3cos .1X
4. Press [2nd] [CALC] and select **intersection**. The graph is displayed. Select First curve, Second curve, and Guess for the intersection at the left of the display. The solution is displayed, and the value of **X** at the intersection, which is the lower limit of the integral, is stored in **Ans** and **X**.
5. Press [2nd] [DRAW] and use **Shade(** to see the area graphically.

   Shade(Y_2,Y_1,1,Ans,75)



6. Press [2nd] [QUIT] to return to the Home screen. Enter the expression to evaluate the integral for the shaded region.

   fnInt(Y_1–Y_2,X,Ans,75)

   The area is **325.839962**.

Chapter 15: Memory Ma

This chapter d
TI-82. To incre
use, occasiona
items that you
the calculator,

Chapter Contents

Checking Avail
Deleting Items
Resetting the T

Curves

region bounded by
+ 625)

ct the default MODE settings. Press [Y=]
unctions. Press [2nd] [STAT PLOT] and
lots.

et the viewing WINDOW.

Ymin = -5
Ymax = 10
Yscl = 1

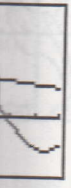
he upper and lower functions.

25)

and select **intersection**. The graph is
First curve, Second curve, and Guess
on at the left of the display. The
ved, and the value of **X** at the
ch is the lower limit of the integral, is
X.

and use **Shade(** to see the area

ns,75)



o return to the Home screen. Enter
evaluate the integral for the shaded

,75)

9962.

Chapter 15: Memory Management

This chapter describes how to manage memory on the TI-82. To increase the amount of memory available for use, occasionally you may want to delete from memory items that you are no longer using. You also can reset the calculator, erasing all data and programs.

Chapter Contents

Checking Available Memory 15-2
Deleting Items from Memory 15-3
Resetting the TI-82 15-4

Checking Available Memory

The MEMORY Check RAM screen displays the total amount of available memory and the amount of memory used by each variable type. This allows you to determine the amount of memory available for new items such as programs and the amount used by old items that you no longer need.

Displaying the MEM FREE Screen

1. Press 2nd [MEM] to display the MEMORY screen.

```
MEMORY
1:Check RAM...
2:Delete...
3:Reset...
```

2. Select **Check RAM...**.

```
MEM FREE 28754
Real          15
List           0
Matrix         0
Y-Vars       240
Prgm          14
Pic            0
GDB            0
```

   The number of bytes used by each variable type is shown on the right.

3. To leave the Check RAM display:
   - To go to the Home screen, press 2nd [QUIT].
   - To return to the MEMORY screen, press 2nd [MEM].

Deleting Items from Mem

You can delete t list, matrix, Y= f database from

Deleting an Item

1. Press 2nd [ME
2. Select **Delete**

```
DELETE FR
1:All...
2:Real...
3:List...
4:Matrix...
5:Y-Vars...
6:Prgm...
7↓Pic...
```

3. Select the typ select **All...**, a appears listin used by each

   For example, screen appea

```
DELETE:L
▸L1
 L2
```

4. Use ▲ and ▼ by ▸ in the le delete, and p immediately.

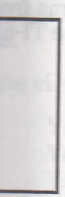
You can continu screen. To leave

- To go to the
- To return to

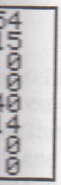
Note: Some syst **Ans** and statistic

RAM screen displays the total
memory and the amount of memory
e type. This allows you to determine
ry available for new items such as
ount used by old items that you no

display the MEMORY screen.



....



s used by each variable type is

RAM display:

ne screen, press [2nd] [QUIT].

MEMORY screen, press [2nd] [MEM].

Deleting Items from Memory

You can delete the contents of any variable (real number, list, matrix, Y= function), program, picture, or graph database from memory to increase available memory.

Deleting an Item

1. Press [2nd] [MEM] to display the MEMORY screen.
2. Select **Delete...**.

3. Select the type of item that you want to delete. (If you select **All...**, a list of all items is displayed.) A screen appears listing all variables of that type and the amount used by each.

   For example, if you select **List...**, the DELETE:List screen appears.

4. Use [▲] and [▼] to position the cursor, which is indicated by ▸ in the left column, next to the item you want to delete, and press [ENTER]. The item is deleted immediately.

You can continue to delete individual items from this screen. To leave the DELETE display:

- To go to the Home screen, press [2nd] [QUIT].
- To return to the MEMORY screen, press [2nd] [MEM].

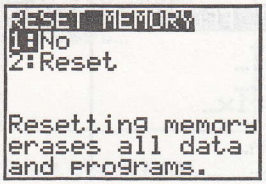
Note: Some system variables can't be deleted; for example, **Ans** and statistical variables such **RegEQ**.

Resetting the TI-82

Resetting the TI-82 restores memory to the factory settings, including deleting the contents of all variables and programs and resetting all system variables to their original settings. Because you can increase available memory by deleting individual items, you should rarely need to reset the TI-82.

Resetting

1. Press [2nd] [MEM] to display the MEMORY screen.
2. Select **Reset...**.



3. Make the appropriate menu selection:
   - To go to the Home screen without resetting memory, select **No**.
   - To reset memory, select **Yes**. The Home screen is displayed with the message Mem cleared.

Note: Reset resets the contrast to the factory setting. If the screen is blank, you need to adjust the display contrast. Press [2nd] and then press and hold [▲] (to make the display darker) or [▼] (to make the display lighter). You can press [CLEAR] to clear the message on the display.

Chapter 16: Communicati

The TI-82 has a p another TI-82 or v describes how to

Chapter Contents

Getting Started: S
TI-82 LINK ....
Selecting Items .
Transmitting Item
Receiving Items
Backing Up Memo

-82 restores memory to the factory
ng deleting the contents of all variables
nd resetting all system variables to the
. Because you can increase available
ting individual items, you should rarely
e TI-82.

M] to display the MEMORY screen.

opriate menu selection:

e Home screen without resetting memory.

emory, select **Yes**. The Home screen is
ith the message Mem cleared.

ts the contrast to the factory setting. If
k, you need to adjust the display
and then press and hold ▲ (to make
) or ▼ (to make the display lighter). You
o clear the message on the display.

Chapter 16: Communication Link

The TI-82 has a port to let you communicate with another TI-82 or with a PC or Macintosh®. This chapter describes how to communicate with another TI-82.

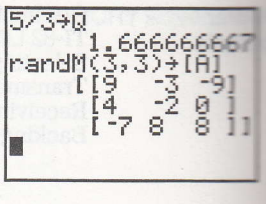
Chapter Contents

Getting Started: Sending Variables 16-2
TI-82 LINK 16-3
Selecting Items 16-4
Transmitting Items 16-6
Receiving Items 16-7
Backing Up Memory 16-8

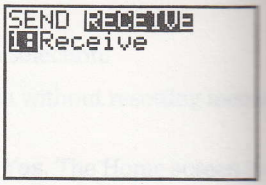
Getting Started is a fast-paced introduction. Read the chapter for details.

Create and store a variable and a random matrix and then transfer them to another TI-82.

1. On the Home screen, press **5** [÷] **3** [STO▸] [ALPHA] **Q** [ENTER].
2. Press [MATRX] [▸] **6** (to select **randM(**). Press **3** [,] **3** [)] [STO▸] [MATRX] **1** (to select **[A]**) [ENTER] to store a random matrix into **[A]**.

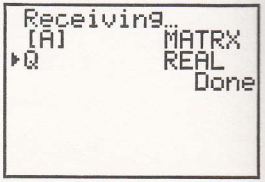


3. Connect the calculators together with the cable.
4. On the receiving unit, press [2nd] [LINK] [▸] to display the RECEIVE menu. Press **1** (to select **Receive**). The message Waiting... is displayed.



5. On the sending unit, press [2nd] [LINK] to display the SEND menu. Press **2** to select **SelectAll–** and display the SELECT screen with no items selected.
6. Press [▾] until the cursor is on the line with **[A]**. Press [ENTER]. The square dot indicates that **[A]** is selected to send.
7. Press [▾] until the cursor is on the line with **Q**. Press [ENTER] to select **Q** also.

8. On the sending unit, press [▸] to place the cursor on TRANSMIT.
9. Press **1** (to select **Transmit**) and begin transmission. The items are transmitted and both units display the names and types of the transmitted variables.



The TI-82 comm variables and pr another TI-82 or TI-82 screens on

Linking to Another TI-82

The software for is built into the T

The cable to link

Note: You canno other TI graphing

Linking to a PC or Macintosh

An optional acce communicate wi special cable, co compatible comp instruction book Relations at 1-80

Connecting the Cable

The TI-82 LINK p edge of the calcu

1. Insert either
2. Repeat with t

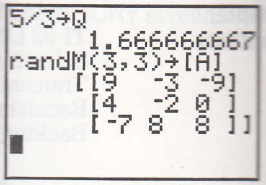
Leaving a LINK Screen or Menu

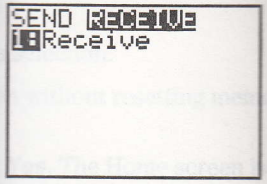
To leave LINK:

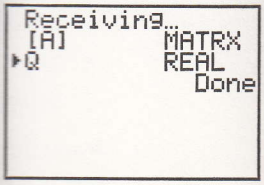
- While transm to leave the E
- After transmi

TI-82 LINK

The TI-82 communication capability lets you share variables and programs or entire memory backup with another TI-82 or with a personal computer. You can print TI-82 screens on a printer connected to a computer.







Linking to Another TI-82

The software for one TI-82 to communicate with another is built into the TI-82. The instructions are in this chapter.

The cable to link the calculators comes with the TI-82.

Note: You cannot transmit items between the TI-82 and other TI graphing calculators such as the TI-85.

Linking to a PC or Macintosh

An optional accessory, TI-GRAPH LINK™, allows a TI-82 to communicate with a personal computer. To obtain the special cable, computer software (for either an IBM®-compatible computer or a Macintosh®), and the instruction booklet, contact Texas Instruments Consumer Relations at 1-800-842-2737 (1-800-TI-CARES).

Connecting the Cable

The TI-82 LINK port is located at the center of the bottom edge of the calculator.

1. Insert either end of the cable into the port **very firmly**.
2. Repeat with the other TI-82.

Leaving a LINK Screen or Menu

To leave LINK:

- While transmitting, press [ON] to interrupt and then **Quit** to leave the ERROR screen.
- After transmitting, press [2nd] [QUIT].

Selecting Items

You can send individual items (variables), all items, or a memory backup from one TI-82 to another. To transmit from the TI-82, you first select what you want to send. The transmission does not begin until you select from the TRANSMIT menu.

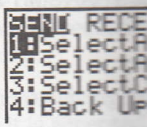
What You Can Send

You may transmit:

- Programs
- Graph databases
- Pictures
- Lists
- Matrices
- Y= functions
- Window settings (sent as a group)
- RclWindow settings (sent as a group)
- Table settings (sent as a group)
- Real variables

Selecting Items to Send

1. Press [2nd] [LIN



2. For convenie
with all of th
ones from th

- **SelectAll+**
- **SelectAll-**
- **SelectCu**
(page 16-

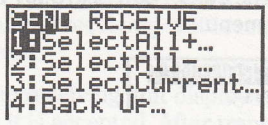
The SELECT
continue to s
names are m

3. ▶ at the left
Use [▼] and [

Press [ENTER]
where the cu

Selecting Items to Send

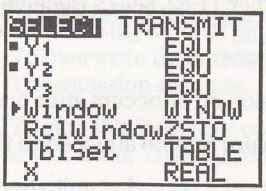
1. Press [2nd] [LINK] to display the LINK SEND menu.



2. For convenience, you can display the individual items with all of them selected, none of them selected, or the ones from the last transmission selected.

   - **SelectAll+** displays with all items selected.
   - **SelectAll–** displays with no items selected.
   - **SelectCurrent** reselects all currently selected items (page 16-6).

   The SELECT screen is displayed where you may continue to select or deselect individual items. Selected names are marked with a ■.



3. ▶ at the left of an item indicates the selection cursor. Use [▼] and [▲] to move the cursor.

   Press [ENTER] to reverse the selection status of the item where the cursor is located.

Transmitting Items

Once you have selected what to send and the receiving unit is ready, you can begin transmitting. For easy distribution of items to several TI-82 units, current items remain selected in both the sending and receiving unit. It is easy to transmit the items again.

Transmitting Items

After you have selected the items you want to send, press ▶ to move the cursor to TRANSMIT and display the TRANSMIT menu.

```
SELECT TRANSMIT
1:Transmit
```

Be sure that the receiving unit is set to Receive (page 16-7). Press ENTER to select **Transmit**.

The name and type of each item is displayed, one per line, as the TI-82 tries to transmit it. After transmission is complete for all items, Done is displayed. Press ▲ and ▼ to scroll through the names. The Home screen is displayed.

Transmitting Items to an Additional TI-82

After sending or receiving data, you can repeat the same transmission to a different TI-82 from either the sending unit or the receiving unit without selecting what to send. The current items remain selected.

Before you make another selection, simply connect the unit to another TI-82, select **Receive** on the new unit, and then press 2nd [LINK] **3** (to select **SelectCurrent...**) ▶ **1** (to select **Transmit**).

Error Conditions

A transmission error occurs after one or two seconds if:

- There is not a cable attached to the sending unit.
- There is not a receiving unit attached to the cable.
- The receiving unit is not in Receive mode.

Note: If the cable is attached, push it in more firmly and try again.

If the ON key is pressed to interrupt transmission, an ERROR screen is displayed. Select **Exit** to leave the ERROR screen.

Receiving Items

Items are not tr
If the receiving
you have the op
to a new name.

Receiving Unit

When you select
the busy indicat
and the receivin
items.

The receiving u
as it is accepted
items, the mess
scroll through t
select **Receive**

To leave Receiv
Select **Quit** to le

Duplicate Name

If an item of tha
receiving unit di

- To store the
After the Na
name that is
keyboard is
Transmissio
- To overwrite
Transmissio
- To skip this
select **Omit**.
- To leave Rec

Insufficient Memory in Receiving Unit

If the receiving
receive the item
Full menu.

- To skip this
with the nex
- To leave Rec

elected what to send and the receiving
can begin transmitting. For easy
ms to several TI-82 units, current items
n both the sending and receiving unit. It
it the items again.

ected the items you want to send, press
sor to TRANSMIT and display the

ceiving unit is set to Receive
ENTER to select **Transmit.**

e of each item is displayed, one per line,
o transmit it. After transmission is
ems, Done is displayed. Press ▲ and ▼
he names. The Home screen is displayed.

ceiving data, you can repeat the same
different TI-82 from either the sending
g unit without selecting what to send.
remain selected.

nother selection, simply connect the
82, select **Receive** on the new unit, and
K] **3** (to select **SelectCurrent...**) ▶ **1**
t).

or occurs after one or two seconds if:

able attached to the sending unit.

eceiving unit attached to the cable.

nit is not in Receive mode.

s attached, push it in more firmly and

essed to interrupt transmission, an
isplayed. Select **Exit** to leave the

Receiving Items

Items are not transmitted until the receiving unit is ready. If the receiving unit already has a variable with that name, you have the opportunity to overwrite it, skip it, or save it to a new name.

Receiving Unit

When you select **Receive** from the LINK RECEIVE menu, the busy indicator and the message Waiting... is displayed and the receiving unit is ready to receive transmitted items.

The receiving unit displays the name and type of each item as it is accepted. After transmission is complete for all items, the message Done is displayed. Press ▲ and ▼ to scroll through the names. The unit is not in Receive mode; select **Receive** to receive new items.

To leave Receive mode without receiving items, press ON. Select **Quit** to leave the ERROR screen.

Duplicate Name

If an item of that name exists in the receiving unit, the receiving unit displays the DuplicateName menu.

- To store the item to a different name, select **Rename.** After the Name= on the prompt line, enter a variable name that is not being used in the receiving unit (the keyboard is in ALPHA-LOCK). Press ENTER. Transmission resumes.
- To overwrite the existing item, select **Overwrite.** Transmission resumes.
- To skip this item (not copy it to the receiving unit), select **Omit.** Transmission resumes with the next item.
- To leave Receive mode, select **Quit.**

Insufficient Memory in Receiving Unit

If the receiving unit does not have sufficient memory to receive the item, the receiving unit displays the Memory Full menu.

- To skip this item, select **Omit.** Transmission resumes with the next item.
- To leave Receive mode, select **Quit.**

Backup transmits all items in memory to the receiving unit.

Memory Backup

To copy the exact contents of memory in the sending unit to the memory of the receiving unit, put the other unit in Receive mode and select **Backup** from the LINK menu.

- Select **Transmit** to begin transmission.
- **Warning:** Backup overwrites the memory in the receiving unit and all information in the memory of the receiving unit is lost. If you do not want to do a backup, select **Quit** to return to the LINK menu.

Receiving Unit

As a safety check to prevent accidental loss of memory, when the receiving unit receives notice of a backup, the message WARNING Memory Backup is displayed.

- To continue with the backup process, select **Continue**. The transmission will begin.
- To prevent the backup, select **Quit**.

Note: If a transmission error occurs during a backup, the receiving unit is reset.

This appendix pr you can use in e use on the Home

Appendix Contents

Table of Function
Menu Map . . . .
Table of Variable

Appendix A: Tables

This appendix provides a list of all TI-82 functions that you can use in expressions and instructions that you can use on the Home screen and in programs.

Appendix Contents

Table of Functions and Instructions A-2
Menu Map A-22
Table of Variables A-28

Table of Functions and Instructions

Functions (F) return a value, list, or matrix and can be used in an expression; instructions (I) initiate an action. Some, but not all, have arguments. † indicates that the instruction is available only in the program editor.

abs *value*	Returns absolute value of *value*. **(F)**	2nd [ABS]	2-6
abs *list*	Returns absolute value of *list* elements. **(F)**	2nd [ABS]	2-6
abs *matrix*	Returns matrix of absolute values of *matrix* elements. **(F)**	2nd [ABS]	10-10
Addition: *valueA*+*valueB*	Returns *valueA* plus *valueB*. **(F)**	+	2-9
Addition: *value*+*list*	Returns list in which *value* is added to each *list* element. **(F)**	+	2-9
Addition: *listA*+*listB*	Returns *listA* elements plus *listB* elements. **(F)**	+	2-9
Addition: *matrixA*+*matrixB*	Returns *matrixA* elements plus *matrixB* elements. **(F)**	+	10-10
valueA **and** *valueB*	Returns 1 if both *valueA* and *valueB* are ≠ 0. **(F)**	2nd [TEST] LOGIC ⟨and⟩	2-16
augment(*matrixA*,*matrixB***)**	Returns *matrixA* augmented by *matrixB*. **(F)**	MATRX MATH ⟨augment⟩	10-14
AxesOff	Sets axis FORMAT off. **(I)**	† WINDOW FORMAT ⟨AxesOff⟩	3-10
AxesOn	Sets axis FORMAT on. **(I)**	† WINDOW FORMAT ⟨AxesOn⟩	3-10
Circle(*X*,*Y*,*radius***)**	Draws a circle of center (*X*,*Y*) and *radius*. **(I)**	2nd [DRAW] DRAW ⟨Circle⟩	8-9
ClrDraw	Deletes all drawn elements from a graph or drawing. **(I)**	2nd [DRAW] DRAW ⟨ClrDraw⟩	8-16

ClrHome	Clear (I)	
ClrList *listA*,*listB*, . . .	Clear *listA*	
ClrTable	Clear table	
Connected	Sets graph	
CoordOff	Does coor	
CoordOn	Displ coor	
cos *value*	Retu (F)	
cos *list*	Retu elem	
cos^{-1} *value*	Retu *valu*	
cos^{-1} *list*	Retu elem	
cosh *value*	Retu cosi	
cosh *list*	Retu cosi (F)	
cosh^{-1} *value*	Retu arcc	
cosh^{-1} *list*	Retu arcc elem	
Cube: *value*^{3}	Retu (F)	
Cube: *list*^{3}	Retu elem	
Cube: *matrix*^{3}	Retu (I)	
Cube root: $\sqrt[3]{value}$	Retu *valu*	
Cube root: $\sqrt[3]{list}$	Retu elem	

ix and can be used in an
tion. Some, but not all, have
on is available only in the

te value	2nd [ABS]	2-4
te value . (F)	2nd [ABS]	2-4
of of ts. (F)	2nd [ABS]	10-10
plus	+	2-3
which o each)	+	2-3
lements ents. (F)	+	2-3
:A natrixB	+	10-10
h valueA ≠ 0. (F)	2nd [TEST] LOGIC ⟨and⟩	2-16
:A natrixB.	MATRX MATH ⟨augment⟩	10-14
AT off. (I)	† WINDOW FORMAT ⟨AxesOff⟩	3-10
AT on. (I)	† WINDOW FORMAT ⟨AxesOn⟩	3-10
of center s. (I)	2nd [DRAW] DRAW ⟨Circle(⟩	8-9
m a graph	2nd [DRAW] DRAW ⟨ClrDraw⟩	8-16

ClrHome	Clears the Home screen. **(I)**	† PRGM I/O ⟨ClrHome⟩ 13-17
ClrList *listA*,*listB*, . . .	Clears all values from *listA*, *listB*, . . . **(I)**	STAT EDIT ⟨ClrList⟩ 12-12
ClrTable	Clears all values from table. **(I)**	† PRGM I/O ⟨ClrTable⟩ 13-17
Connected	Sets connected line graphing format. **(I)**	† MODE ⟨Connected⟩ 1-11
CoordOff	Does not display cursor coordinate values. **(I)**	† WINDOW FORMAT ⟨CoordOff⟩ 3-10
CoordOn	Displays cursor coordinate values. **(I)**	† WINDOW FORMAT ⟨CoordOn⟩ 3-10
cos *value*	Returns cosine of *value*. **(F)**	COS 2-3
cos *list*	Returns cosine of *list* elements. **(F)**	COS 2-3
cos^{-1} *value*	Returns arccosine of *value*. **(F)**	2nd [cos^{-1}] 2-3
cos^{-1} *list*	Returns arccosine of *list* elements. **(F)**	2nd [cos^{-1}] 2-3
cosh *value*	Returns hyperbolic cosine of *value*. **(F)**	MATH HYP ⟨cosh⟩ 2-11
cosh *list*	Returns hyperbolic cosine of *list* elements. **(F)**	MATH HYP ⟨cosh⟩ 2-11
cosh^{-1} *value*	Returns hyperbolic arccosine of *value*. **(F)**	MATH HYP ⟨cosh^{-1}⟩ 2-11
cosh^{-1} *list*	Returns hyperbolic arccosine of *list* elements. **(F)**	MATH HYP ⟨cosh^{-1}⟩ 2-11
Cube: *value*^{3}	Returns cube of *value*. **(F)**	MATH MATH ⟨^{3}⟩ 2-6
Cube: *list*^{3}	Returns cube of *list* elements. **(F)**	MATH MATH ⟨^{3}⟩ 2-6
Cube: *matrix*^{3}	Returns *matrix* cubed. **(I)**	MATH MATH ⟨^{3}⟩ 10-11
Cube root: $\sqrt[3]{value}$	Returns cube root of *value*. **(F)**	MATH MATH ⟨$\sqrt[3]{}$⟩ 2-6
Cube root: $\sqrt[3]{list}$	Returns cube root of *list* elements. **(F)**	MATH MATH ⟨$\sqrt[3]{}$⟩ 2-6

CubicReg	Fits data to cubic model using lists from SET UP CALCS. **(I)**	[STAT] CALC ⟨CubicReg⟩	13-10
CubicReg *Xlist*,*Ylist*	Fits *Xlist* and *Ylist* to cubic model. **(I)**	[STAT] CALC ⟨CubicReg⟩	13-10
CubicReg *Xlist*,*Ylist*,*Flist*	Fits *Xlist* and *Ylist* to cubic model with frequency *Flist*. **(I)**	[STAT] CALC ⟨CubicReg⟩	13-10
value▶**Dec**	Displays *value* as decimal. **(I)**	[MATH] MATH ⟨▶Dec⟩	2-9
list▶**Dec**	Displays *list* as decimal. **(I)**	[MATH] MATH ⟨▶Dec⟩	2-9
matrix▶**Dec**	Displays *matrix* as decimal. **(I)**	[MATH] MATH ⟨▶Dec⟩	2-9
Degree	Sets degree MODE. **(I)**	† [MODE] ⟨Degree⟩	1-10
Degree notation: *angle*°	Interprets *angle* as degrees. **(F)**	[2nd] [ANGLE] ⟨°⟩	2-10
DependAsk	Sets table without dependent variables. **(I)**	† [PRGM] [2nd] [TblSet] ⟨DependAsk⟩	7-6
DependAuto	Sets table to generate dependent variables. **(I)**	† [PRGM] [2nd] [TblSet] ⟨DependAuto⟩	7-6
det *matrix*	Returns determinant of *matrix*. **(F)**	[MATRX] MATH ⟨det⟩	10-10
dim *list*	Returns length of *list*. **(F)**	[2nd] [LIST] OPS ⟨dim⟩	11-7
dim *matrix*	Returns dimensions of *matrix* as a list. **(F)**	[MATRX] MATH ⟨dim⟩	10-12,10
length→**dim** *listname*	Creates (if necessary) or redimensions *list* to *length*. **(I)**	[2nd] [LIST] OPS ⟨dim⟩	11-7
{*row*,*col*}→**dim** *matrixname*	Creates (if necessary) or redimensions *matrix* to *row* × *col*. **(I)**	[MATRX] MATH ⟨dim⟩	10-13
Disp	Displays Home screen. **(I)**	† [PRGM] I/O ⟨Disp⟩	13-14
Disp *valueA*,*valueB*, . . .	Displays *valueA*, *valueB*, . . . **(I)**	† [PRGM] I/O ⟨Disp⟩	13-14
DispGraph	Displays graph. **(I)**	† [PRGM] I/O ⟨DispGraph⟩	13-15
DispTable	Displays table. **(I)**	† [PRGM] I/O ⟨DispTable⟩	13-15

Division: *valueA*/*valueB*	Re by	
Division: *list*/*value*	Re div	
Division: *value*/*list*	Re *lis*	
Division: *listA*/*listB*	Re div ele	
answer▶**DMS**	Dis for	
Dot	Se for	
DrawF *expression*	Dr on	
DrawInv *expression*	Dr ex cu gr	
DS<(*variable*,*value*) :*commandA* :*commands*	De 1, va	
e^power	Re po	
e^list	Re to	
Else *See* **If:Then:Else**		
End	In Fo El	
Eng	Se M	
Equal: *valueA*=*valueB*	Re va va	
Equal: *listA*=*listB*	Re el Re of	
Equal: *matrixA*=*matrixB*	Re el m ar ≠	

ructions (Continued)

o cubic model from SET UP	STAT CALC ⟨CubicReg⟩	12-15
nd *Ylist* to el. **(I)**	STAT CALC ⟨CubicReg⟩	12-15
nd *Ylist* to el with *Flist*. **(I)**	STAT CALC ⟨CubicReg⟩	12-15
alue as	MATH MATH ⟨▶Dec⟩	2-6
st as decimal.	MATH MATH ⟨▶Dec⟩	2-6
atrix as	MATH MATH ⟨▶Dec⟩	2-6
MODE. **(I)**	† MODE ⟨Degree⟩	1-11
ngle as	2nd [ANGLE] ⟨°⟩	2-13
vithout variables. **(I)**	† PRGM 2nd [TblSet] ⟨DependAsk⟩	7-5
o generate variables. **(I)**	† PRGM 2nd [TblSet] ⟨DependAuto⟩	7-5
terminant of	MATRX MATH ⟨det⟩	10-12
gth of *list*. **(F)**	2nd [LIST] OPS ⟨dim⟩	11-7
nensions of list. **(F)**	MATRX MATH ⟨dim⟩	10-12,13
necessary) or ns *list* to	2nd [LIST] OPS ⟨dim⟩	11-7
necessary) or ns *matrix* to	MATRX MATH ⟨dim⟩	10-13
me screen.	† PRGM I/O ⟨Disp⟩	13-14
lueA, valueB,	† PRGM I/O ⟨Disp⟩	13-14
ph. **(I)**	† PRGM I/O ⟨DispGraph⟩	13-15
le. **(I)**	† PRGM I/O ⟨DispTable⟩	13-15

Division: *valueA/valueB*	Returns *valueA* divided by *valueB*. **(F)**	÷ 2-3
Division: *list/value*	Returns *list* elements divided by *value*. **(F)**	÷ 2-3
Division: *value/list*	Returns *value* divided by *list* elements. **(F)**	÷ 2-3
Division: *listA/listB*	Returns *listA* elements divided by *listB* elements. **(F)**	÷ 2-3
answer▶**DMS**	Displays *answer* in DMS format. **(I)**	2nd [ANGLE] ⟨▶DMS⟩ 2-14
Dot	Sets dot graphing format. **(I)**	† MODE ⟨Dot⟩ 1-11
DrawF *expression*	Draws *expression* (in **X**) on current graph. **(I)**	2nd [DRAW] DRAW ⟨DrawF⟩ 8-7
DrawInv *expression*	Draws inverse of *expression* (in **X**) on current **Func** MODE graph. **(I)**	2nd [DRAW] DRAW ⟨DrawInv⟩ 8-7
DS<(*variable,value***)** *:commandA* *:commands*	Decrements *variable* by 1, skips *commandA* if *variable*<*value*. **(I)**	† PRGM CTL ⟨DS<(⟩ 13-10
e^*power*	Returns **e** raised to *power*. **(F)**	2nd [e^x] 2-4
e^*list*	Returns a list of **e** raised to *list* elements. **(F)**	2nd [e^x] 2-4
Else *See* **If:Then:Else**		
End	Indentifies end of **While**, **For**, **Repeat**, or **If-Then-Else** loop. **(I)**	† PRGM CTL ⟨End⟩ 13-9
Eng	Sets engineering display MODE. **(I)**	† MODE ⟨Eng⟩ 1-10
Equal: *valueA=valueB*	Returns 1if *valueA* = *valueB*. Returns 0 if *valueA* ≠ *valueB*. **(F)**	2nd [TEST] TEST ⟨=⟩ 2-15
Equal: *listA=listB*	Returns 1 if every element of *listA* = *listB*. Returns 0 if any element of *listA* ≠ *listB*. **(F)**	2nd [TEST] TEST ⟨=⟩ 2-15
Equal: *matrixA=matrixB*	Returns 1 if every element of *matrixA* = *matrixB*. Returns 0 if any element of *matrixA* ≠ *matrixB*. **(F)**	2nd [TEST] TEST ⟨=⟩ 10-11

Table of Functions and Instructions (Continued)

Exponent: *value*E*exponent*	Returns *value* times 10 to the *exponent*. **(F)**	2nd [EE]	
Exponent: *list*E*exponent*	Returns *list* elements time 10 to the *exponent*. **(F)**	2nd [EE]	
Exponent: *matrix*E*exponent*	Returns *matrix* elements times 10 to the *exponent*. **(F)**	2nd [EE]	
ExpReg	Fits data to exponential model using lists from SET UP CALCS. **(I)**	STAT CALC ⟨ExpReg⟩	
ExpReg *Xlist*,*Ylist*	Fits *Xlist* and *Ylist* to exponential model. **(I)**	STAT CALC ⟨ExpReg⟩	
ExpReg *Xlist*,*Ylist*,*Flist*	Fits *Xlist* and *Ylist* to exponential model with frequency *Flist*.**(I)**	STAT CALC ⟨ExpReg⟩	
Factorial: *value*!	Returns factorial of *value* (0≤integer≤69). **(F)**	MATH PRB ⟨!⟩	
Factorial: *list*!	Returns factorial of *list* elements. **(F)**	MATH PRB ⟨!⟩	
Fill(*value*,*matrixname*)	Stores *value* to each element in *matrixname*. **(I)**	MATRX MATH ⟨Fill(⟩	
Fill(*value*,*listname*)	Stores *value* to each element in *listname*. **(I)**	2nd [LIST] OPS ⟨Fill(⟩	
Fix *n*	Sets fixed display MODE for *n* decimal places. **(I)**	† MODE ⟨Fix⟩	
Float	Sets floating display MODE. **(I)**	† MODE ⟨Float⟩	
fMax(*expression*,*variable*, *lower*,*upper*)	Returns value of *variable* where maximum of *expression* occurs, between *lower* and *upper*. Tolerance is 1E-5. **(F)**	MATH MATH ⟨fMax⟩	2-6
fMax(*expression*,*variable*, *lower*,*upper*,*tolerance*)	Returns value of *variable* where maximum of *expression* occurs, between *lower* and *upper*, with specified *tolerance*. **(F)**	MATH MATH ⟨fMax⟩	2-6
fMin(*expression*,*variable*, *lower*,*upper*)	Retu *varia* minir occu and 1E-5.		
fMin(*expression*,*variable*, *lower*,*upper*,*tolerance*)	Retu *varia* minir occu and speci		
fnInt(*expression*,*variable*, *lower*,*upper*)	Retu of ex respe betw *uppe* (F)		
fnInt(*expression*,*variable*, *lower*,*upper*,*tolerance*)	Retu of ex respe betw *uppe toler*		
FnOff	Dese func		
FnOff *funcA*,*funcB*, . . .	Dese . . . (		
FnOn	Sele (I)		
FnOn *funcA*,*funcB*, . . .	Sele . . . (		
For(*variable*,*begin*,*end*) :*commands* . . . **:End**	Exe thro incr from *vari*		
For(*variable*,*begin*,*end*, *increment*) :*commands* . . . **:End**	Exe thro incr from until		
fPart *value*	Retu of v		
fPart *list*	Retu of e		

tructions (Continued)

alue times 10 *onent.* **(F)**	2nd [EE]	1-7
ist elements o the *exponent.*	2nd [EE]	1-7
matrix times 10 to the t. **(F)**	2nd [EE]	1-7
to exponential sing lists from CALCS. **(I)**	STAT CALC ⟨ExpReg⟩	12-16
t and *Ylist* to tial model. **(I)**	STAT CALC ⟨ExpReg⟩	12-16
t and *Ylist* to tial model with cy *Flist*.**(I)**	STAT CALC ⟨ExpReg⟩	12-16
factorial of ≤integer≤69). **(F)**	MATH PRB ⟨!⟩	2-12
factorial of *list* s. **(F)**	MATH PRB ⟨!⟩	2-12
alue to each t in *matrixname.*	MATRX MATH ⟨Fill⟩	10-13
alue to each t in *listname.* **(I)**	2nd [LIST] OPS ⟨Fill⟩	11-8
ed display MODE ecimal places. **(I)**	† MODE ⟨Fix⟩	1-10
ating display **(I)**	† MODE ⟨Float⟩	1-10
s value of *le* where um of *expression* , between *lower* *per*. Tolerance is F)	MATH MATH ⟨fMax⟩	2-6
s value of *le* where um of *expression* s, between *lower* *per*, with ied *tolerance*. **(F)**	MATH MATH ⟨fMax⟩	2-6

fMin(*expression,variable, lower,upper***)**	Returns value of *variable* where minimum of *expression* occurs, between *lower* and *upper*. Tolerance is 1E-5. **(F)**	MATH MATH ⟨fMin⟩ 2-6
fMin(*expression,variable, lower,upper,tolerance***)**	Returns value of *variable* where minimum of *expression* occurs, between *lower* and *upper*, with specified *tolerance*. **(F)**	MATH MATH ⟨fMin⟩ 2-6
fnInt(*expression,variable, lower,upper***)**	Returns function integral of *expression* with respect to *variable*, between *lower* and *upper*. Tolerance is 1E-5. **(F)**	MATH MATH ⟨fnInt⟩ 2-7
fnInt(*expression,variable, lower,upper,tolerance***)**	Returns function integral of *expression* with respect to *variable*, between *lower* and *upper*, with specified *tolerance*. **(F)**	MATH MATH ⟨fnInt⟩ 2-7
FnOff	Deselects all Y= functions. **(I)**	2nd [Y-VARS] ON/OFF ⟨FnOff⟩ 3-7
FnOff *funcA,funcB, . . .*	Deselects *funcA, funcB, . . .* **(I)**	2nd [Y-VARS] ON/OFF ⟨FnOff⟩ 3-7
FnOn	Selects all Y= functions. **(I)**	2nd [Y-VARS] ON/OFF ⟨FnOn⟩ 3-7
FnOn *funcA,funcB, . . .*	Selects *funcA, funcB, . . .* **(I)**	2nd [Y-VARS] ON/OFF ⟨FnOn⟩ 3-7
For(*variable,begin,end***)** **:***commands . . .* **:End**	Executes *commands* through **End**, incrementing *variable* from *begin* by 1 until *variable>end*. **(I)**	† PRGM CTL ⟨For⟩ 13-8
For(*variable,begin,end, increment***)** **:***commands . . .* **:End**	Executes *commands* through **End**, incrementing *variable* from *begin* by *increment* until *variable>end*. **(I)**	† PRGM CTL ⟨For⟩ 13-8
fPart *value*	Returns fractional part of *value*. **(F)**	MATH NUM ⟨fPart⟩ 2-9
fPart *list*	Returns fractional part of each *list* element. **(F)**	MATH NUM ⟨fPart⟩ 2-9

Table of Functions and Instructions (Continued)

fPart *matrix*	Returns fractional part of each *matrix* element. **(F)**	MATH NUM ⟨fPart⟩	10-13
value▶**Frac**	Displays *value* as most simplified fraction. **(I)**	MATH MATH ⟨▶Frac⟩	2-6
list▶**Frac**	Displays *list* elements as most simplified fractions. **(I)**	MATH MATH ⟨▶Frac⟩	10-6
matrix▶**Frac**	Displays *matrix* elements as most simplified fractions. **(I)**	MATH MATH ⟨▶Frac⟩	2-6
FullScreen	Sets display MODE to show full screen. **(I)**	† MODE ⟨FullScreen⟩	1-10
Func	Sets function graphing MODE. **(I)**	† MODE ⟨Func⟩	1-10
Get(*variable***)**	Gets contents of *variable* from external device and stores in *variable*. **(I)**	† PRGM I/O ⟨Get(⟩	13-17
getKey	Returns value of last keystroke. **(F)**	† PRGM I/O ⟨getKey⟩	13-16
Goto *label*	Transfers control to *label*. **(I)**	† PRGM CTL ⟨Goto⟩	13-10
Greater than: *valueA*>*valueB*	Returns 1 if *valueA* > *valueB*. Returns 0 if *valueA* ≤ *valueB*. **(F)**	2nd [TEST] TEST ⟨>⟩	2-15
Greater than: *listA*>*listB*	Returns 1 if *listA* element > *listB* element. Otherwise returns 0. **(F)**	2nd [TEST] TEST ⟨>⟩	2-15
Greater than or equal: *valueA*≥*valueB*	Returns 1 if *valueA* ≥ *valueB*. Returns 0 if *valueA* < *valueB*. **(F)**	2nd [TEST] TEST ⟨≥⟩	2-15
Greater than or equal: *listA*≥*listB*	Returns 1 if *listA* element ≥ *listB* element. Otherwise returns 0. **(F)**	2nd [TEST] TEST ⟨≥⟩	2-15
GridOff	Sets grid FORMAT off. **(I)**	† WINDOW FORMAT ⟨GridOff⟩	3-10
GridOn	Sets grid FORMAT on. **(I)**	† WINDOW FORMAT ⟨GridOn⟩	3-10
Horizontal *Y*	Draws horizontal line at *Y*. **(I)**	2nd [DRAW] DRAW ⟨Horizontal⟩	8-5
identity *dim*	Returns identity matrix *dim* × *dim*. **(F)**	MATRX MATH ⟨identity⟩	10-13

If *condition*:*commandA* :*commands*	If *condi* skips *co*	
If *condition* :**Then**:*commands*:**End**	Execute from **Th** *conditi*	
If *condition* :**Then**:*commands* :**Else**:*commands*:**End**	Execute from **Th** *conditi* from **El** *conditi*	
IndpntAsk	Sets tab indepe	
IndpntAuto	Sets tab indepe	
Input	Displa	
Input *variable*	Prompt store t	
Input "*string*",*variable*	Displa stores *variab*	
Int *value*	Return **(F)**	
Int *list*	Return eleme	
Int *matrix*	Return integer of *mat*	
Inverse: $value^{-1}$	Return *value*	
Inverse: $list^{-1}$	Return eleme	
Inverse: $matrix^{-1}$	Return **(F)**	
iPart *value*	Return *value*	
iPart *list*	Return *list* el	
iPart *matrix*	Return integer eleme	
IS>(*variable*,*value***)** :*commandA* :*commands*	Incre 1, ski *varia*	

uctions (Continued)

tional part rix element.	MATH NUM ⟨fPart⟩	10-11
ue as most action. **(I)**	MATH MATH ⟨▶Frac⟩	2-6
elements as ied	MATH MATH ⟨▶Frac⟩	11-2
trix most actions. **(I)**	MATH MATH ⟨▶Frac⟩	2-6
MODE to een. **(I)**	† MODE ⟨FullScreen⟩	1-11
graphing	† MODE ⟨Func⟩	1-11
s of n external tores in	† PRGM I/O ⟨Get(⟩	13-17
e of last	† PRGM I/O ⟨getKey⟩	13-16
ntrol to	† PRGM CTL ⟨Goto⟩	13-10
alueA > ns 0 if *ueB*. **(F)**	2nd [TEST] TEST ⟨>⟩	2-15
istA *tB* element. turns 0. **(F)**	2nd [TEST] TEST ⟨>⟩	2-15
alueA ≥ ns 0 if *ueB*. **(F)**	2nd [TEST] TEST ⟨≥⟩	2-15
istA *tB* element. turns 0. **(F)**	2nd [TEST] TEST ⟨≥⟩	2-15
MAT off. **(I)**	† WINDOW FORMAT ⟨GridOff⟩	3-10
MAT on. **(I)**	† WINDOW FORMAT ⟨GridOn⟩	3-10
ntal line at	2nd [DRAW] DRAW ⟨Horizontal⟩	8-5
ity matrix F)	MATRX MATH ⟨identity⟩	10-13

If *condition*:*commandA* :*commands*	If *condition* = 0 (false), skips *commandA*. **(I)**	† PRGM CTL ⟨If⟩ 13-7
If *condition* **:Then**:*commands*:**End**	Executes *commands* from **Then** to **End** if *condition* = 1 (true). **(I)**	† PRGM CTL ⟨Then⟩ 13-8
If *condition* **:Then**:*commands* **:Else**:*commands*:**End**	Executes *commands* from **Then** to **Else** if *condition* = 1 (true); from **Else** to **End** if *condition* = 0 (false). **(I)**	† PRGM CTL ⟨Else⟩ 13-8
IndpntAsk	Sets table without independent values. **(I)**	† PRGM 2nd [TblSet] ⟨IndpntAsk⟩ 7-5
IndpntAuto	Sets table to generate independent values. **(I)**	† PRGM 2nd [TblSet] ⟨IndpntAuto⟩ 7-5
Input	Displays graph. **(I)**	† PRGM I/O ⟨Input⟩ 13-13
Input *variable*	Prompts for value to store to *variable*. **(I)**	† PRGM I/O ⟨Input⟩ 13-13
Input "*string***",***variable*	Displays *string* and stores entered value to *variable*. **(I)**	† PRGM I/O ⟨Input⟩ 13-13
int *value*	Returns integer ≥ *value*. **(F)**	MATH NUM ⟨int⟩ 2-10
int *list*	Returns integer ≥ *list* element. **(F)**	MATH NUM ⟨int⟩ 2-10
int *matrix*	Returns matrix of integers ≥ each element of *matrix*. **(F)**	MATH NUM ⟨int⟩ 10-11
Inverse: $value^{-1}$	Returns 1 divided by *value*. **(F)**	x^{-1} 2-3
Inverse: $list^{-1}$	Returns 1 divided by *list* elements. **(F)**	x^{-1} 2-3
Inverse: $matrix^{-1}$	Returns *matrix* inverted. **(F)**	x^{-1} 10-11
iPart *value*	Returns integer part of *value*. **(F)**	MATH NUM ⟨iPart⟩ 2-9
iPart *list*	Returns integer part of *list* element. **(F)**	MATH NUM ⟨iPart⟩ 2-9
iPart *matrix*	Returns matrix of integer part of each element of *matrix*. **(F)**	MATH NUM ⟨iPart⟩ 10-11
IS>(*variable*,*value***)** :*commandA* :*commands*	Increments *variable* by 1, skips *commandA* if *variable*>*value*. **(I)**	† PRGM CTL ⟨IS>(⟩ 13-10

LabelOff	Sets axis label FORMAT off. **(I)**	† [WINDOW] FORMAT ⟨LabelOff⟩	3-10
LabelOn	Sets axis label FORMAT on. **(I)**	† [WINDOW] FORMAT ⟨LabelOn⟩	3-10
Lbl *label*	Assigns *label* to the command. **(I)**	† [PRGM] CTL ⟨Lbl⟩	13-10
Less than: *valueA*<*valueB*	Returns 1 if *valueA* < *valueB*. Returns 0 if *valueA* ≥ *valueB*. **(F)**	[2nd] [TEST] TEST ⟨<⟩	2-15
Less than: *listA*<*listB*	Returns 1 if *listA* element < *listB* element; otherwise returns 0. **(F)**	[2nd] [TEST] TEST ⟨<⟩	2-15
Less than or equal: *valueA*≤*valueB*	Returns 1 if *valueA* ≤ *valueB*. Returns 0 if *valueA* > *valueB*. **(F)**	[2nd] [TEST] TEST ⟨≤⟩	2-15
Less than or equal: *listA*≤*listB*	Returns 1 if *listA* element ≤ *listB* element. Otherwise returns 0. **(F)**	[2nd] [TEST] TEST ⟨≤⟩	2-15
Line(*X1***,***Y1***,***X2***,***Y2***)**	Draws line from (*X1*,*Y1*) to (*X2*,*Y2*). **(I)**	[2nd] [DRAW] DRAW ⟨Line⟩	8-4
Line(*X1***,***Y1***,***X2***,***Y2***,0)**	Erases line from (*X1*,*Y1*) to (*X2*,*Y2*). **(I)**	[2nd] [DRAW] DRAW ⟨Line⟩	8-4
LinReg(a+bx) **LinReg(ax+b)**	Fits data to linear model using lists from SET UP CALCS. **(I)**	[STAT] CALC ⟨LinReg(a+bx)⟩ ⟨LinReg(ax+b)⟩	12-15 12-16
LinReg(a+bx) *Xlist*,*Ylist* **LinReg(ax+b)** *Xlist*,*Ylist*	Fits *Xlist* and *Ylist* to linear model. **(I)**	[STAT] CALC ⟨LinReg(a+bx)⟩ [STAT] CALC ⟨LinReg(ax+b)⟩	12-15 12-16
LinReg(a+bx) *Xlist*,*Ylist*, *Flist* **LinReg(ax+b)** *Xlist*,*Ylist*, *Flist*	Fits *Xlist* and *Ylist* to linear model with frequency *Flist*. **(I)**	[STAT] CALC ⟨LinReg(a+bx)⟩ [STAT] CALC ⟨LinReg(ax+b)⟩	12-15 12-16
ln *value*	Returns natural logarithm of *value*. **(F)**	[LN]	2-4
ln *list*	Returns natural logarithm of *list* elements. **(F)**	[LN]	2-4
LnReg	Fits data to logarithmic model using lists from SET UP CALCS. **(I)**	[STAT] CALC ⟨LnReg⟩	12-16
LnReg *Xlist*,*Ylist*	Fits *Xlist* and *Ylist* to logarithmic model. **(I)**	[STAT] CALC ⟨LnReg⟩	12-16

LnReg *Xlist*,*Ylist*,*Flist*	Fits *Xli* logarith frequen
log *value*	Returns *value*. (
log *list*	Returns elemen
max(*valueA*,*valueB***)**	Returns and val
max(*list***)**	Returns in *list*.
max(*listA*,*listB***)**	Returns larger elemen *listB*. (
mean(*list***)**	Returns (F)
mean(*list*,*Flist***)**	Returns with fr
Med-Med	Fits da median from S
Med-Med *Xlist*,*Ylist*	Fits *Xl* media (I)
Med-Med *Xlist*,*Ylist*,*Flist*	Fits *Xl* media with fr
median(*list***)**	Return *list*. (F
median(*list*,*Flist***)**	Return *list* wi (F)
Menu("*title***","***text***",***label*, "*text*",*label*, . . .)	Sets u to 7 m
min(*valueA*,*valueB***)**	Return *value*
min(*list***)**	Return eleme
min(*listA*,*listB***)**	Return each *listA*

structions (Continued)

s label FORMAT	† WINDOW FORMAT ⟨LabelOff⟩	3-10
s label FORMAT	† WINDOW FORMAT ⟨LabelOn⟩	3-10
label to the nd. (I)	† PRGM CTL ⟨Lbl⟩	13-10
1 if *valueA* < Returns 0 if ≥ *valueB*. (F)	2nd [TEST] TEST ⟨<⟩	2-15
1 if *listA* < *listB* element; se returns 0. (F)	2nd [TEST] TEST ⟨<⟩	2-15
1 if *valueA* ≤ Returns 0 if > *valueB*. (F)	2nd [TEST] TEST ⟨≤⟩	2-15
1 if *listA* ≤ *listB* element. se returns 0. (F)	2nd [TEST] TEST ⟨≤⟩	2-15
ne from (*X*1,*Y*1)). (I)	2nd [DRAW] DRAW ⟨Line⟩	8-4
ne from (*X*1,*Y*1)). (I)	2nd [DRAW] DRAW ⟨Line⟩	8-4
to linear model s from SET UP I)	STAT CALC ⟨LinReg(a+bx)⟩ ⟨LinReg(ax+b)⟩	12-15 12-16
and *Ylist* to del. (I)	STAT CALC ⟨LinReg(a+bx)⟩ STAT CALC ⟨LinReg(ax+b)⟩	12-15 12-16
and *Ylist* to del with *Flist*. (I)	STAT CALC ⟨LinReg(a+bx)⟩ STAT CALC ⟨LinReg(ax+b)⟩	12-15 12-16
atural of *value*. (F)	LN	2-4
atural of *list* (F)	LN	2-4
to logarithmic ing lists from CALCS. (I)	STAT CALC ⟨LnReg⟩	12-16
and *Ylist* to ic model. (I)	STAT CALC ⟨LnReg⟩	12-16

LnReg *Xlist*,*Ylist*,*Flist*	Fits *Xlist* and *Ylist* to logarithmic model with frequency *Flist*. (I)	STAT CALC ⟨LnReg⟩ 12-16
log *value*	Returns logarithm of *value*. (F)	LOG 2-4
log *list*	Returns logarithm of *list* elements. (F)	LOG 2-4
max(*valueA*,*valueB*)	Returns larger of *valueA* and *valueB*. (F)	MATH NUM ⟨max⟩ 2-10
max(*list*)	Returns largest element in *list*. (F)	2nd [LIST] MATH ⟨max⟩ 11-9
max(*listA*,*listB*)	Returns a list of the larger of each pair of elements in *listA* and *listB*. (F)	2nd [LIST] MATH ⟨max⟩ 11-9
mean(*list*)	Returns the mean of *list*. (F)	2nd [LIST] MATH ⟨mean⟩ 11-9
mean(*list*,*Flist*)	Returns the mean of *list* with frequency *Flist*. (F)	2nd [LIST] MATH ⟨mean⟩ 11-9
Med-Med	Fits data to median-median model using lists from SET UP CALCS. (I)	STAT CALC ⟨Med-Med⟩ 12-15
Med-Med *Xlist*,*Ylist*	Fits *Xlist* and *Ylist* to median-median model. (I)	STAT CALC ⟨Med-Med⟩ 12-15
Med-Med *Xlist*,*Ylist*,*Flist*	Fits *Xlist* and *Ylist* to median-median model with frequency *Flist*. (I)	STAT CALC ⟨Med-Med⟩ 12-15
median(*list*)	Returns the median of *list*. (F)	2nd [LIST] MATH ⟨median⟩ 11-9
median(*list*,*Flist*)	Returns the median of *list* with frequency *Flist*. (F)	2nd [LIST] MATH ⟨median⟩ 11-9
Menu("*title*","*text*",*label*, "*text*",*label*, . . .)	Sets up branches for up to 7 menu items. (I)	† PRGM CTL ⟨Menu⟩ 13-11
min(*valueA*,*valueB*)	Returns smaller of *valueA* and *valueB*. (F)	MATH NUM ⟨min⟩ 2-10
min(*list*)	Returns smallest element in *list*. (F)	2nd [LIST] MATH ⟨min⟩ 11-9
min(*listA*,*listB*)	Returns list of smaller of each pair of elements in *listA* and *listB*. (F)	2nd [LIST] MATH ⟨min⟩ 11-9

Table of Functions and Instructions (Continued)

Minute notation: *degrees'minutes'seconds'*	Interprets angle as *degrees*, *minutes*, and *seconds*. **(F)**	2nd [ANGLE] ⟨'⟩	2-10
Multiplication: *valueA***valueB*	Returns *valueA* times *valueB*. **(F)**	×	2-3
Multiplication: *value***list*	Returns *value* times each *list* element. **(F)**	×	2-3
Multiplication: *list***value*	Returns each *list* element times *value*. **(F)**	×	2-3
Multiplication: *listA***listB*	Returns *listA* elements times *listB* elements. **(F)**	×	2-3
Multiplication: *value***matrix*	Returns *value* times *matrix* elements. **(F)**	×	10-10
Multiplication: *matrixA***matrixB*	Returns *matrixA* times *matrixB*. **(F)**	×	10-10
items **nCr** *number*	Returns combinations of *items* (integer≥0) taken *number* (integer≥0) at a time. **(F)**	MATH PRB ⟨nCr⟩	2-12
nDeriv(*expression*, *variable*,*value***)**	Returns approximate numerical derivative of *expression* with respect to *variable* at *value*. ε is 1E-3. **(F)**	MATH MATH ⟨nDeriv⟩	2-7
nDeriv(*expression*, *variable*,*value*,ε**)**	Returns approximate numerical derivative of *expression* with respect to *variable* at *value*, with specified ε. **(F)**	MATH MATH ⟨nDeriv⟩	2-7
Negation: **-***value*	Returns negative of *value*. **(F)**	(-)	2-4
Negation: **-***list*	Returns *list* with each element negated. **(F)**	(-)	2-4
Negation: **-***matrix*	Returns *matrix* with each element negated. **(F)**	(-)	10-10

Normal			
not *value*			
Not equal: *valueA*≠*valueB*			
Not equal: *listA*≠*listB*			
Not equal: *matrixA*≠*matrixB*			
items **nPr** *number*			
1-Var Stats			
1-Var Stats *Xlist*			
1-Var Stats *Xlist*,*Flist*			
valueA **or** *valueB*			
Output(*line*,*column*,"*text*"**)**			
Output(*line*,*column*,*value***)**			

ctions (Continued)

gle as *utes*, and	2nd [ANGLE] ⟨'⟩	2-13
eA times	×	2-3
e times nent. **(F)**	×	2-3
list s *value*. **(F)**	×	2-3
elements ements. **(F)**	×	2-3
e times nts. **(F)**	×	10-10
ixA times	×	10-10
inations of r≥0) taken ger≥0) at a	MATH PRB ⟨nCr⟩	2-12
ximate ivative of ith respect *value*. ε is	MATH MATH ⟨nDeriv⟩	2-7
ximate ivative of ith respect *value*, with)	MATH MATH ⟨nDeriv⟩	2-7
ive of	(-)	2-4
ith each ed. **(F)**	(-)	2-4
ix with negated.	(-)	10-10

Normal	Sets normal display MODE. **(I)**	† MODE ⟨Normal⟩ 1-10
not *value*	Returns 0 if *value* is ≠ 0. **(F)**	2nd [TEST] LOGIC ⟨not⟩ 2-16
Not equal: *valueA≠valueB*	Returns 1 if *valueA* ≠ *valueB*. Returns 0 if *valueA* = *valueB*. **(F)**	2nd [TEST] TEST ⟨≠⟩ 2-15
Not equal: *listA≠listB*	Returns 1 if *listA* element ≠ *listB* element. Otherwise, returns 0. **(F)**	2nd [TEST] TEST ⟨≠⟩ 2-15
Not equal: *matrixA≠matrixB*	Returns 1 if *matrixA* element ≠ *matrixB* element. Otherwise, returns 0. **(F)**	2nd [TEST] TEST ⟨≠⟩ 10-11
items **nPr** *number*	Returns permutations of *items* (0≤integer) taken *number* (0≤integer) at a time. **(F)**	MATH PRB ⟨nPr⟩ 2-12
1-Var Stats	Performs one-variable analysis using lists from SET UP CALCS. **(I)**	STAT CALC ⟨1-Var Stats⟩ 12-14
1-Var Stats *Xlist*	Performs one-variable analysis using *Xlist* and a frequency of 1. **(I)**	STAT CALC ⟨1-Var Stats⟩ 12-14
1-Var Stats *Xlist,Flist*	Performs one-variable analysis using *Xlist* and frequencies from *Ylist*. **(I)**	STAT CALC ⟨1-Var Stats⟩ 12-14
valueA **or** *valueB*	Returns 1 if *valueA* or *valueB* is ≠ 0. **(F)**	2nd [TEST] LOGIC ⟨or⟩ 2-16
Output(*line,column,"text"***)**	Displays *text* beginning at specified *line* and *column*. **(I)**	† PRGM I/O ⟨Output⟩ 13-15
Output(*line,column,value***)**	Displays *value* beginning at specified *line* and *column*. **(I)**	† PRGM I/O ⟨Output⟩ 13-15

Par	Sets parametric graphing MODE. **(I)**	† MODE ⟨Par⟩	1-11
Pause	Suspends program execution until ENTER is pressed. **(I)**	† PRGM CTL ⟨Pause⟩	13-10
Pause *value*	Displays *value*, suspends program execution until ENTER is pressed. **(I)**	† PRGM CTL ⟨Pause⟩	13-10
Plot#(*type*,*Xlist*,*Ylist*, *mark***)**	Defines **Plot#** (1-3) of *type* **Scatter** or **xyList** for *Xlist* and *Ylist* using *mark*. **(I)**	† 2nd [STAT PLOT] ⟨Plot*n*⟩	12-20
Plot#(*type*,*Xlist*,*Flist***)**	Defines **Plot#** (1-3) of *type* **Histogram** or **Boxplot** for *Xlist* with frequency *Flist*. **(I)**	† 2nd [STAT PLOT] ⟨Plot*n*⟩	12-20
PlotsOff	Deselects all stat plots. **(I)**	† 2nd [STAT PLOT] ⟨PlotsOff⟩	12-21
PlotsOff *plot#*,*plot#*, . . .	Deselects stat **Plot1**, **Plot2**, or **Plot3**. **(I)**	† 2nd [STAT PLOT] ⟨PlotsOff⟩	12-21
PlotsOn	Selects all stat plots. **(I)**	† 2nd [STAT PLOT] ⟨PlotsOn⟩	12-21
PlotsOn *plot#*,*plot#*, . . .	Selects stat **Plot1**, **Plot2**, or **Plot3**. **(I)**	† 2nd [STAT PLOT] ⟨PlotsOn⟩	12-21
Pol	Sets polar graphing MODE. **(I)**	† MODE ⟨Pol⟩	1-11
PolarGC	Sets polar graphing coordinates. **(I)**	† WINDOW FORMAT ⟨PolarGC⟩	3-10
Power of ten: **10^***value*	Returns 10 raised to *value* power. **(F)**	2nd [10^x]	2-4
Power of ten: **10^***list*	Returns list of 10 raised to *list* power. **(F)**	2nd [10^x]	2-4
Powers: *value*^*power*	Returns *value* raised to *power*. **(F)**	^	2-3
Powers: *list*^*power*	Returns *list* elements raised to *power*. **(F)**	^	2-3
Powers: *value*^*list*	Returns *value* raised to *list* elements. **(F)**	^	2-3
Powers: *matrix*^*power*	Returns *matrix* elements raised to *power*. **(F)**	^	10-11
prgm*name*	Executes program *name*. **(I)**	PRGM CTRL ⟨prgm⟩	13-11
PrintScreen	Sends current display to printer. **(I)**	† PRGM I/O ⟨PrintScreen⟩	13-17

prod *list*	Return elemen	
Prompt *varA*,*varB*, . . .	Prompt *varA*,	
P▸Rx(*R*,θ**)**	Return coordi	
P▸Ry(*R*,θ**)**	Return coordi	
Pt-Change(*X*,*Y***)**	Chang (I)	
Pt-Off(*X*,*Y***)**	Erases	
Pt-On(*X*,*Y***)**	Draws	
PwrReg	Fits d using CALC	
PwrReg *Xlist*,*Ylist*	Fits *X* power	
PwrReg *Xlist*,*Ylist*,*Flist*	Fits *X* power freque	
Pxl-Change(*row*,*column***)**	Chang *colum* 0≤*colu*	
Pxl-Off(*row*,*column***)**	Erase *colum* 0≤*colu*	
Pxl-On(*row*,*column***)**	Draws *colum* 0≤*colu*	
pxl-Test(*row*,*column***)**	Retur (*row*, it is o 0≤*colu*	
QuadReg	Fits d mode SET U	
QuadReg *Xlist*,*Ylist*	Fits *X* quadr	
QuadReg *Xlist*,*Ylist*,*Flist*	Fits *X* quadr freque	

structions (Continued)

rametric graphing l)	† MODE ⟨Par⟩	1-11
ls program on until ENTER is . (I)	† PRGM CTL ⟨Pause⟩	13-10
value, suspends n execution until pressed. (I)	† PRGM CTL ⟨Pause⟩	13-10
Plot# (1-3) of **atter** or **xyList** and *Ylist* using)	† 2nd [STAT PLOT] ⟨Plot*n*⟨⟩	12-20
Plot# (1-3) of **togram** or for *Xlist* with *cy Flist*. (I)	† 2nd [STAT PLOT] ⟨Plot*n*⟨⟩	12-20
ts all stat plots.	† 2nd [STAT PLOT] ⟨PlotsOff⟩	12-21
ts stat **Plot1**, **Plot3**. (I)	† 2nd [STAT PLOT] ⟨PlotsOff⟩	12-21
ll stat plots. (I)	† 2nd [STAT PLOT] ⟨PlotsOn⟩	12-21
tat **Plot1**, **Plot2**, . (I)	† 2nd [STAT PLOT] ⟨PlotsOn⟩	12-21
ar graphing)	† MODE ⟨Pol⟩	1-11
ar graphing ates. (I)	† WINDOW FORMAT ⟨PolarGC⟩	3-10
10 raised to wer. (F)	2nd [10^x]	2-4
list of 10 raised wer. (F)	2nd [10^x]	2-4
value raised to F)	^	2-3
list elements *power*. (F)	^	2-3
value raised to ents. (F)	^	2-3
matrix s raised to F)	^	10-11
s program)	PRGM CTRL ⟨prgm⟩	13-11
rrent display to I)	† PRGM I/O ⟨PrintScreen⟩	13-17

prod *list*	Returns product of *list* elements. (F)	2nd [LIST] MATH ⟨prod⟩ 11-10
Prompt *varA*,*varB*, . . .	Prompts for value for *varA*, then *varB*, etc. (I)	† PRGM I/O ⟨Prompt⟩ 13-15
P▶Rx(*R*,θ)	Returns **X**, given polar coordinates *R* and θ. (F)	2nd [ANGLE] ⟨P▶Rx⟨ 2-14
P▶Ry(*R*,θ)	Returns **Y**, given polar coordinates *R* and θ. (F)	2nd [ANGLE] ⟨P▶Ry⟨ 2-14
Pt-Change(*X*,*Y*)	Changes point at (*X*,*Y*). (I)	2nd [DRAW] POINTS ⟨Pt-Change⟨ 8-12
Pt-Off(*X*,*Y*)	Erases point at (*X*,*Y*). (I)	2nd [DRAW] POINTS ⟨Pt-Off⟨ 8-12
Pt-On(*X*,*Y*)	Draws point at (*X*,*Y*). (I)	2nd [DRAW] POINTS ⟨Pt-On⟨ 8-12
PwrReg	Fits data to power model using lists from SET UP CALCS. (I)	STAT CALC ⟨PwrReg⟩ 12-16
PwrReg *Xlist*,*Ylist*	Fits *Xlist* and *Ylist* to power model. (I)	STAT CALC ⟨PwrReg⟩ 12-16
PwrReg *Xlist*,*Ylist*,*Flist*	Fits *Xlist* and *Ylist* to power model with frequency *Flist*. (I)	STAT CALC ⟨PwrReg⟩ 12-16
Pxl-Change(*row*,*column*)	Changes pixel at (*row*, *column*); 0≤*row*≤62 and 0≤*column*≤94. (I)	2nd [DRAW] POINTS ⟨Pxl-Change⟨ 8-13
Pxl-Off(*row*,*column*)	Erases pixel at (*row*, *column*); 0≤*row*≤62 and 0≤*column*≤94. (I)	2nd [DRAW] POINTS ⟨Pxl-Off⟨ 8-13
Pxl-On(*row*,*column*)	Draws pixel at (*row*, *column*); 0≤*row*≤62 and 0≤*column*≤94. (I)	2nd [DRAW] POINTS ⟨Pxl-On⟨ 8-13
pxl-Test(*row*,*column*)	Returns 1 if pixel (*row*, *column*) is on, 0 if it is off; 0≤*row*≤62 and 0≤*column*≤94. (F)	2nd [DRAW] POINTS ⟨pxl-Test⟨ 8-13
QuadReg	Fits data to quadratic model using lists from SET UP CALCS. (I)	STAT CALC ⟨QuadReg⟩ 12-15
QuadReg *Xlist*,*Ylist*	Fits *Xlist* and *Ylist* to quadratic model. (I)	STAT CALC ⟨QuadReg⟩ 12-15
QuadReg *Xlist*,*Ylist*,*Flist*	Fits *Xlist* and *Ylist* to quadratic model with frequency *Flist*. (I)	STAT CALC ⟨QuadReg⟩ 12-15

Table of Functions and Instructions (Continued)

QuartReg	Fits data to quartic model using lists from SET UP CALCS. **(I)**	[STAT] CALC ⟨QuartReg⟩	12-18
QuartReg *Xlist*,*Ylist*	Fits *Xlist* and *Ylist* to quartic model. **(I)**	[STAT] CALC ⟨QuartReg⟩	12-18
QuartReg *Xlist*,*Ylist*,*Flist*	Fits *Xlist* and *Ylist* to quartic model with frequency *Flist*. **(I)**	[STAT] CALC ⟨QuartReg⟩	12-18
angle^{r}	Interprets *angle* as radians. **(F)**	[2nd] [ANGLE] ⟨^{r}⟩	3-10
Radian	Sets radian MODE. **(I)**	† [MODE] ⟨Radian⟩	1-10
rand	Returns random number between 0 and 1. **(F)**	[MATH] PRB ⟨rand⟩	2-12
randM(*rows*,*columns***)**	Returns a *rows* (1-99) × *columns* (1-99) random matrix. **(F)**	[MATRX] MATH ⟨randM(⟩	10-10
RecallGDB GDB*n*	Recalls graph database **GDB***n* as the current graph. **(I)**	[2nd] [DRAW] STO ⟨RecallGDB⟩	8-15
RecallPic Pic*n*	Recalls picture **Pic***n* onto current graph. **(I)**	[2nd] [DRAW] STO ⟨RecallPic⟩	8-14
RectGC	Sets rectangular graphing coordinates. **(I)**	† [WINDOW] FORMAT ⟨RectGC⟩	3-10
Repeat *condition* :*commands*:**End**	Execute *commands* until *condition* is true. **(I)**	† [PRGM] CTL ⟨Repeat⟩	13-9
Return	Returns to calling program. **(I)**	† [PRGM] CTL ⟨Return⟩	13-12
$n^{th}root\sqrt[x]{}value$	Returns $n^{th}root$ of *value*. **(F)**	[MATH] MATH ⟨$\sqrt[x]{}$⟩	2-6
$n^{th}root\sqrt[x]{}list$	Returns $n^{th}root$ of *list* elements. **(F)**	[MATH] MATH ⟨$\sqrt[x]{}$⟩	2-6
$list\sqrt[x]{}value$	Returns *list* roots of *value*. **(F)**	[MATH] MATH ⟨$\sqrt[x]{}$⟩	2-6
$listA\sqrt[x]{}listB$	Returns *list* roots of *list*. **(F)**	[MATH] MATH ⟨$\sqrt[x]{}$⟩	2-6
round(*value***)**	Returns *value* rounded to 10 digits. **(F)**	[MATH] NUM ⟨round(⟩	2-9
round(*value*,*#decimals***)**	Returns *value* rounded to *#decimals* (≤9). **(F)**	[MATH] NUM ⟨round(⟩	2-9
round(*list***)**	Returns *list* elements rounded to 10 digits. **(F)**	[MATH] NUM ⟨round(⟩	2-9

round(*list*,*#decimals***)**	Returns rounde (≤9). (F
round(*matrix***)**	Returns elemen digits.
round(*matrix*,*#decimals***)**	Returns elemen *#decim*
rowSwap(*matrix*,*rowA*, *rowB***)**	Returns *rowA* o swappe
row+(*matrix*,*rowA*,*rowB***)**	Returns *rowA* o to *row* *rowB*.
row(value*,*matrix*,*row***)**	Returns of *mat* *value* a (F)
row+(value*,*matrix*, *rowA*,*rowB***)**	Returns *rowA* o multipl added stored
R▶Pr(*X*,*Y***)**	Returns rectang *X* and
R▶Pθ(*X*,*Y***)**	Returns rectang *X* and
Sci	Sets sc MODE.
Send(*variable***)**	Sends *variab* device
Seq	Sets M sequen
seq(*expression*,*variable*, *begin*,*end*,*increment***)**	Returns evalua for *va* to *end*
Sequential	Sets M sequen

ructions (Continued)

o quartic ng lists from ALCS. **(I)**	STAT CALC ⟨QuartReg⟩	12-15
and *Ylist* to odel. **(I)**	STAT CALC ⟨QuartReg⟩	12-15
and *Ylist* to odel with *Flist*. **(I)**	STAT CALC ⟨QuartReg⟩	12-15
angle as	2nd [ANGLE] ⟨r⟩	2-13
n MODE. **(I)**	† MODE ⟨Radian⟩	1-11
ndom number and 1. **(F)**	MATH PRB ⟨rand⟩	2-12
rows (1-99) × 1-99) random	MATRX MATH ⟨randM(⟩	10-13
aph database he current	2nd [DRAW] STO ⟨RecallGDB⟩	8-15
ture **Pic***n* nt graph. **(I)**	2nd [DRAW] STO ⟨RecallPic⟩	8-14
gular oordinates. **(I)**	† WINDOW FORMAT ⟨RectGC⟩	3-10
mmands tion is true. **(I)**	† PRGM CTL ⟨Repeat⟩	13-9
calling	† PRGM CTL ⟨Return⟩	13-12
root of *value*.	MATH MATH ⟨$\sqrt[x]{}$⟩	2-6
root of *list* F)	MATH MATH ⟨$\sqrt[x]{}$⟩	2-6
t roots of	MATH MATH ⟨$\sqrt[x]{}$⟩	2-6
t roots of *list*.	MATH MATH ⟨$\sqrt[x]{}$⟩	2-6
lue rounded . **(F)**	MATH NUM ⟨round(⟩	2-9
lue rounded ls (≤9). **(F)**	MATH NUM ⟨round(⟩	2-9
t elements 10 digits. **(F)**	MATH NUM ⟨round(⟩	2-9

round(*list*,*#decimals***)**	Returns *list* elements rounded to *#decimals* (≤9). **(F)**	MATH NUM ⟨round(⟩ 2-9
round(*matrix***)**	Returns *matrix* elements rounded to 10 digits. **(F)**	MATH NUM ⟨round(⟩ 10-11
round(*matrix*,*#decimals***)**	Returns *matrix* elements rounded to *#decimals*. **(F)**	MATH NUM ⟨round(⟩ 10-11
rowSwap(*matrix*,*rowA*, *rowB***)**	Returns matrix with *rowA* of *matrix* swapped with *rowB*. **(F)**	MATRX MATH ⟨rowSwap(⟩ 10-14
row+(*matrix*,*rowA*,*rowB***)**	Returns matrix with *rowA* of *matrix* added to *rowB* and stored in *rowB*. **(F)**	MATRX MATH ⟨row+(⟩ 10-14
row(value*,*matrix*,*row***)**	Returns matrix with *row* of *matrix* multiplied by *value* and stored in *row*. **(F)**	MATRX MATH ⟨*row(⟩ 10-14
row+(value*,*matrix*, *rowA*,*rowB***)**	Returns matrix with *rowA* of *matrix* multiplied by *value*, added to *rowB*, and stored in *rowB*. **(F)**	MATRX MATH ⟨*row+(⟩ 10-14
R▶Pr(*X*,*Y***)**	Returns **R**, given rectangular coordinates *X* and *Y*. **(F)**	2nd [ANGLE] ⟨R▶Pr(⟩ 2-14
R▶Pθ(*X*,*Y***)**	Returns θ, given rectangular coordinates *X* and *Y*. **(F)**	2nd [ANGLE] ⟨R▶Pθ(⟩ 2-14
Sci	Sets scientific display MODE. **(I)**	MODE ⟨Sci⟩ 1-10
Send(*variable***)**	Sends contents of *variable* to external device. **(I)**	† PRGM I/O ⟨Send(⟩ 13-17
Seq	Sets MODE to graph sequences. **(I)**	† MODE ⟨Seq⟩ 1-11
seq(*expression*,*variable*, *begin*,*end*,*increment***)**	Returns list created by evaluating *expression* for *variable*, from *begin* to *end* at *increment*. **(F)**	2nd [LIST] OPS ⟨seq(⟩ 11-8
Sequential	Sets MODE to graph sequentially. **(I)**	† MODE ⟨Sequential⟩ 1-11

Shade(*lowerfunc*, *upperfunc*)	Shade area above *lowerfunc* and below *upperfunc*. **(I)**	2nd [DRAW] DRAW ⟨Shade(⟩	8-8
Shade(*lowerfunc*, *upperfunc*,*resolution*)	Shade area above *lowerfunc*, below *upperfunc* with 1<*resolution*<9. **(I)**	2nd [DRAW] DRAW ⟨Shade(⟩	8-8
Shade(*lowerfunc*, *upperfunc*,*resolution*, *Xleft*)	Shade area above *lowerfunc*, below *upperfunc*, to right of **X**=*Xleft*, with 1<*resolution*<9. **(I)**	2nd [DRAW] DRAW ⟨Shade(⟩	8-8
Shade(*lowerfunc*, *upperfunc*,*resolution*, *Xleft*,*Xright*)	Shade area above *lowerfunc*, below *upperfunc*, to right of **X**=*Xleft*, to left of **X**=*Xright*, with 1<*resolution*<9. **(I)**	2nd [DRAW] DRAW ⟨Shade(⟩	8-8
Simul	Sets simultaneous graphing MODE. **(I)**	† MODE ⟨Simul⟩	1-11
sin *value*	Returns sine of *value*. **(F)**	SIN	2-3
sin *list*	Returns sine of *list* elements. **(F)**	SIN	2-3
sin^{-1} *value*	Returns arcsine of *value*. **(F)**	2nd [sin^{-1}]	2-3
sin^{-1} *list*	Returns arcsine of *list* elements. **(F)**	2nd [sin^{-1}]	2-3
sinh *value*	Returns hyperbolic sine of *value*. **(F)**	MATH HYP ⟨sinh⟩	2-11
sinh *list*	Returns hyperbolic sine of *list* elements. **(F)**	MATH HYP ⟨sinh⟩	2-11
sinh^{-1} *value*	Returns hyperbolic arcsine of *value*. **(F)**	MATH HYP ⟨sinh^{-1}⟩	2-11
sinh^{-1} *list*	Returns hyperbolic arcsine of *list* elements. **(F)**	MATH HYP ⟨sinh^{-1}⟩	2-11
solve(*expression*,*variable*, *guess*)	Solves *expression* for *variable* using *guess* (a number or 2-element list), within bounds -1E99 and 1E99. **(F)**	MATH MATH ⟨solve(⟩	2-8
solve(*expression*,*variable*, *guess*,{*lower*,*upper*})			
SortA(*listname*)			
SortA(*listnameI*, *listnameD*,*listnameD*,...)			
SortD(*listname*)			
SortD(*listnameI*, *listnameD*,*listnameD*,...)			
Split			
Square root: $\sqrt{}$*value*			
Square root: $\sqrt{}$*list*			
Squaring: *value*^{2}			
Squaring: *list*^{2}			
Squaring: *matrix*^{2}			
Stop			
Store: *value*→*variable*			
StoreGDB GDB*n*			
StorePic Pic*n*			
Subtraction: *valueA*–*valueB*			
Subtraction: *value*–*list*			
Subtraction: *list*–*value*			

low	2nd [DRAW] DRAW ⟨Shade(⟩	8-8
l)	2nd [DRAW] DRAW ⟨Shade(⟩	8-8
ht of	2nd [DRAW] DRAW ⟨Shade(⟩	
l)		8-8
ht of	2nd [DRAW] DRAW ⟨Shade(⟩	
l)		8-8
s l)	† MODE ⟨Simul⟩	1-11
alue. **(F)**	SIN	2-3
st	SIN	2-3
f *value.*	2nd [$\sin^{-1}$]	2-3
f *list*	2nd [$\sin^{-1}$]	2-3
ic sine	MATH HYP ⟨sinh⟩	2-11
ic sine F)	MATH HYP ⟨sinh⟩	2-11
ic (F)	MATH HYP ⟨$\sinh^{-1}$⟩	2-11
ic ments.	MATH HYP ⟨$\sinh^{-1}$⟩	2-11
n for ess (a ent ds F)	MATH MATH ⟨solve(⟩	2-8

solve(*expression*,*variable*, *guess*,{*lower*,*upper*})	Solves *expression* for *variable* using *guess* (a number or 2-element list), between *lower* and *upper*. **(F)**	MATH MATH ⟨solve(⟩ 2-8
SortA(*listname***)**	Sorts *listname* elements in ascending order. **(I)**	2nd [LIST] OPS ⟨SortA⟩ 11-6
SortA(*listnameI*, *listnameD*,*listnameD*,...)	Sorts elements of *listnameI* in ascending order and *listnameD* as dependent lists. **(I)**	2nd [LIST] OPS ⟨SortA⟩ 11-6
SortD(*listname***)**	Sorts elements of *listname* in descending order. **(I)**	2nd [LIST] OPS ⟨SortD⟩ 11-6
SortD(*listnameI*, *listnameD*,*listnameD*,...)	Sorts elements of *listnameI* in descending order and *listnameD* as dependent lists. **(I)**	2nd [LIST] OPS ⟨SortD⟩ 11-6
Split	Sets split screen display MODE. **(I)**	† MODE ⟨Split⟩ 1-11
Square root: $\sqrt{value}$	Returns square root of *value*. **(F)**	2nd [$\sqrt{}$] 2-3
Square root: $\sqrt{list}$	Returns square root of *list* elements. **(F)**	2nd [$\sqrt{}$] 2-3
Squaring: $value^2$	Returns *value* multiplied by itself. **(F)**	x^2 2-3
Squaring: $list^2$	Returns *list* elements squared. **(F)**	x^2 2-3
Squaring: $matrix^2$	Returns *matrix* multiplied by itself. **(F)**	x^2 10-11
Stop	Ends program execution, returns to Home screen. **(I)**	† PRGM CTL ⟨Stop⟩ 13-12
Store: *value*→*variable*	Stores *value* to *variable*. **(I)**	STO▸ 1-13
StoreGDB GDB*n*	Stores current graph as database **GDB***n*. **(I)**	2nd [DRAW] STO ⟨StoreGDB⟩ 8-15
StorePic Pic*n*	Stores current picture as picture **Pic***n*. **(I)**	2nd [DRAW] STO ⟨StorePic⟩ 8-14
Subtraction: *valueA*–*valueB*	Subtracts *valueB* from *valueA*. **(F)**	− 2-3
Subtraction: *value*–*list*	Subtracts *list* elements from *value*. **(F)**	− 2-3
Subtraction: *list*–*value*	Subtracts *value* from *list* elements. **(F)**	− 2-3

Subtraction: *listA–listB*	Subtracts *listB* elements from *listA* elements. **(F)**	[-]	2-8
Subtraction: *matrixA–matrixB*	Subtracts *matrixB* elements from *matrixA* elements. **(F)**	[-]	10-10
sum *list*	Returns sum of elements of *list*. **(F)**	[2nd] [LIST] MATH ⟨sum⟩	11-10
tan *value*	Returns tangent of *value*. **(F)**	[TAN]	2-8
tan *list*	Returns tangent of *list* elements. **(F)**	[TAN]	2-8
tan^{-1} *value*	Returns arctangent of *value*. **(F)**	[2nd] [tan^{-1}]	2-8
tan^{-1} *list*	Returns arctangent of *list* elements. **(F)**	[2nd] [tan^{-1}]	2-8
Tangent(*expression,value***)**	Draws line tangent to *expression* at **X**=*value*. **(I)**	[2nd] [DRAW] DRAW ⟨Tangent⟩	8-6
tanh *value*	Returns hyperbolic tangent of *value*. **(F)**	[MATH] HYP ⟨tanh⟩	2-11
tanh *list*	Returns hyperbolic tangent of *list* elements. **(F)**	[MATH] HYP ⟨tanh⟩	2-11
tanh^{-1} *value*	Returns hyperbolic arctangent of *value*. **(F)**	[MATH] HYP ⟨tanh^{-1}⟩	2-11
tanh^{-1} *list*	Returns hyperbolic arctangent of *list* elements. **(F)**	[MATH] HYP ⟨tanh^{-1}⟩	2-11
Text(*row,column,valueA,* *valueB . . .***)**	Writes value of *valueA* or "*text*" on graph beginning at pixel (*row,column*). 0≤*row*≤ 57, 0≤*column*≤94. **(I)**	[2nd] [DRAW] DRAW ⟨Text(⟩	8-10
Then *See* **If:Then**			
Time	Sets sequence graphs to plot over time. **(I)**	† [WINDOW] FORMAT ⟨Time⟩	6-5
Trace	Displays graph and enters TRACE mode. **(I)**	† [TRACE]	3-14
Transpose: *matrix*^{T}	Returns *matrix* with elements transposed. **(F)**	[MATRX] MATH ⟨^{T}⟩	10-12

2-Var Stats	P a S
2-Var Stats *Xlist,Ylist*	P a L
2-Var Stats *Xlist,Ylist,Flist*	P a L F
Vertical *X*	D (
Web	S t
While *condition* *:commands*:**End**	E w (
valueA **xor** *valueB*	E c
ZBox	D u v
ZDecimal	D v
ZInteger	D v
Zoom In	D v
Zoom Out	D v
ZoomRcl	D v
ZoomSto	D v
ZoomStat	D v
ZPrevious	D v
ZSquare	D v
ZStandard	D v
ZTrig	D

racts *listB* elements *listA* elements. **(F)**	[−]	2-3
racts *matrixB* ents from *matrixA* ents. **(F)**	[−]	10-10
rns sum of elements t. **(F)**	[2nd] [LIST] MATH ⟨sum⟩	11-10
rns tangent of . **(F)**	[TAN]	2-3
rns tangent of *list* ents. **(F)**	[TAN]	2-3
rns arctangent of . **(F)**	[2nd] [$\tan^{-1}$]	2-3
rns arctangent of lements. **(F)**	[2nd] [$\tan^{-1}$]	2-3
s line tangent to ssion at **X**=*value*.	[2nd] [DRAW] DRAW ⟨Tangent⟩	8-6
ns hyperbolic nt of *value*. **(F)**	[MATH] HYP ⟨tanh⟩	2-11
ns hyperbolic nt of *list* elements.	[MATH] HYP ⟨tanh⟩	2-11
s hyperbolic gent of *value*. **(F)**	[MATH] HYP ⟨$\tanh^{-1}$⟩	2-11
s hyperbolic gent of *list* nts. **(F)**	[MATH] HYP ⟨$\tanh^{-1}$⟩	2-11
value of *valueA* f" on graph ing at pixel olumn). 0≤*row*≤ olumn≤94. **(I)**	[2nd] [DRAW] DRAW ⟨Text(⟩	8-10
quence graphs to er time. **(I)**	† [WINDOW] FORMAT ⟨Time⟩	6-5
s graph and TRACE mode. **(I)**	† [TRACE]	3-14
s *matrix* with ts transposed. **(F)**	[MATRX] MATH ⟨T⟩	10-12

2-Var Stats	Performs two-variable analysis using lists from SET UP CALCS menu. **(I)**	[STAT] CALC ⟨2-Var Stats⟩ 12-14
2-Var Stats *Xlist*,*Ylist*	Performs two-variable analysis using *Xlist* and *Ylist*. **(I)**	[STAT] CALC ⟨2-Var Stats⟩ 12-14
2-Var Stats *Xlist*,*Ylist*,*Flist*	Performs two-variable analysis using *Xlist* and *Ylist* with frequency *Flist*. **(I)**	[STAT] CALC ⟨2-Var Stats⟩ 12-14
Vertical *X*	Draws vertical line at *X*. **(I)**	[2nd] [DRAW] DRAW ⟨Vertical⟩ 8-5
Web	Sets sequence graphs to to trace as webs. **(I)**	† [WINDOW] FORMAT ⟨Web⟩ 6-5
While *condition* :*commands*:**End**	Executes *commands* while *condition* is true. **(I)**	† [PRGM] CTL ⟨While⟩ 13-9
valueA **xor** *valueB*	Returns 1 if only *valueA* or *valueB* = 0. **(F)**	[2nd] [TEST] LOGIC ⟨xor⟩ 2-16
ZBox	Displays graph to allow user to define new viewing WINDOW. **(I)**	[ZOOM] ZOOM ⟨ZBox⟩ 3-16
ZDecimal	Displays graph in new viewing WINDOW. **(I)**	[ZOOM] ZOOM ⟨ZDecimal⟩ 3-18
ZInteger	Displays graph in new viewing WINDOW. **(I)**	[ZOOM] ZOOM ⟨ZInteger⟩ 3-18
Zoom In	Displays graph in new viewing WINDOW. **(I)**	[ZOOM] ZOOM ⟨Zoom In⟩ 3-17
Zoom Out	Displays graph in new viewing WINDOW. **(I)**	[ZOOM] ZOOM ⟨Zoom Out⟩ 3-17
ZoomRcl	Displays graph in new viewing WINDOW. **(I)**	[ZOOM] ZOOM ⟨ZoomRcl⟩ 3-19
ZoomSto	Displays graph in new viewing WINDOW. **(I)**	[ZOOM] ZOOM ⟨ZoomSto⟩ 3-19
ZoomStat	Displays graph in new viewing WINDOW. **(I)**	[ZOOM] ZOOM ⟨ZoomStat⟩ 3-18
ZPrevious	Displays graph in new viewing WINDOW. **(I)**	[ZOOM] ZOOM ⟨ZPrevious⟩ 3-19
ZSquare	Displays graph in new viewing WINDOW. **(I)**	[ZOOM] ZOOM ⟨ZSquare⟩ 3-18
ZStandard	Displays graph in new viewing WINDOW. **(I)**	[ZOOM] ZOOM ⟨ZStandard⟩ 3-18
ZTrig	Displays graph in new viewing WINDOW. **(I)**	[ZOOM] ZOOM ⟨ZTrig⟩ 3-18

TI-82 Menu Map

Menus begin in the upper left of the keyboard. Default values are shown.

[Y=]

(**Func** MODE)	(**Par** MODE)	(**Pol** MODE)	(**Seq** MODE)
Y1=	X1T=	r1=	U*n*=
Y2=	Y1T=	r2=	V*n*=
Y3=	X2T=	r3=	
Y4=	Y2T=	r4=	
...	...	r5=	
Y9=	X6T=	r6=	
Y0=	Y6T=		

[WINDOW]

(**Func** MODE)	(**Par** MODE)	(**Pol** MODE)	(**Seq** MODE)
WINDOW	WINDOW	WINDOW	WINDOW
Xmin=-10	Tmin=0	θmin=0	U*n*Start=0
Xmax=10	Tmax=π*2	θmax=π*2	V*n*Start=0
Xscl=1	Tstep=π/24	θstep=π/24	*n*Start=0
Ymin=-10	Xmin=-10	Xmin=-10	*n*Min=0
Ymax=10	Xmax=10	Xmax=10	*n*Max=10
Yscl=1	Xscl=1	Xscl=1	Xmin=-10
	Ymin=-10	Ymin=-10	Xmax=10
	Ymax=10	Ymax=10	Xscl=1
	Yscl=1	Yscl=1	Ymin=-10
			Ymax=10
			Yscl=1

[WINDOW]

(**Func/Par/Pol** MODE)	(**Seq** MODE)
FORMAT	FORMAT
RectGC PolarGC	Time Web
CoordOn CoordOff	RectGC PolarGC
GridOff GridOn	CoordOn CoordOff
AxesOn AxesOff	GridOff GridOn
LabelOff LabelOn	AxesOn AxesOff
	LabelOff LabelOn

[ZOOM]

ZOOM	MEMORY
1:ZBox	1:ZPrevious
2:Zoom In	2:ZoomSto
3:Zoom Out	3:ZoomRcl
4:ZDecimal	4:SetFactors…
5:ZSquare	
6:ZStandard	
7:ZTrig	
8:ZInteger	
9:ZoomStat	

[ZOOM]

ZOOM FACTORS
XFact=4
YFact=4

[2nd] [CALC]

(**Func** MODE)	(**Par** MODE)
CALCULATE	CALCULATE
1:value	1:value
2:root	2:dy/dx
3:minimum	3:dy/dt
4:maximum	4:dx/dt
5:intersect	
6:dy/dx	
7:∫f(x)dx	

[2nd] [TblSet]

TABLE SETUP
TblMin=0
ΔTbl=1
Indpnt: Auto Ask
Depend: Auto Ask

[2nd] [STAT PLOT]

STAT PLOTS
1:Plot1…
Off L1 L2 □
2:Plot2…
Off L1 L2 □
3:Plot3…
Off L1 L2 □
4:PlotsOff
5:PlotsOn

[STAT]

EDIT	CALC
1:Edit…	1:1-Var Stats
2:SortA(	2:2-Var Stats
3:SortD(	3:SetUp…
4:ClrList	4:Med-Med
	5:LinReg(ax+b
	6:QuadReg
	7:CubicReg
	8:QuartReg
	9:LinReg(a+bx
	0:LnReg
	A:ExpReg
	B:PwrReg

keyboard. Default values are shown.

(Pol MODE)	(Seq MODE)
=	*U*n=
=	*V*n=
=	
=	
=	
=	

(Pol MODE)	(Seq MODE)
WINDOW	WINDOW
min=0	*U*nStart=0
max=π*2	*V*nStart=0
step=π/24	*n*Start=0
min=-10	*n*Min=0
max=10	*n*Max=10
scl=1	Xmin=-10
min=-10	Xmax=10
max=10	Xscl=1
scl=1	Ymin=-10
	Ymax=10
	Yscl=1

rGC
rdOff
dOn
Off
belOn

M FACTORS
Fact=4
Fact=4

2nd [CALC]

(Func MODE)	(Par MODE)	(Pol MODE)	(Seq MODE) (Time FORMAT)
CALCULATE	CALCULATE	CALCULATE	CALCULATE
1:value	1:value	1:value	1:value
2:root	2:dy/dx	2:dy/dx	
3:minimum	3:dy/dt	3:dr/dθ	
4:maximum	4:dx/dt		
5:intersect			
6:dy/dx			
7:∫f(x)dx			

2nd [TblSet]

```
TABLE SETUP
 TblMin=0
 ΔTbl=1
Indpnt: Auto Ask
Depend: Auto Ask
```

2nd [TblSet]

```
(PRGM editor)
TABLE SETUP
Indpnt: Auto Ask
Depend: Auto Ask
```

MODE

```
Normal Sci Eng
Float 0123456789
Radian Degree
Func Par Pol Seq
Connected Dot
Sequential Simul
FullScreen Split
```

2nd [STAT PLOT]

```
STAT PLOTS
1:Plot1…
  Off  L1 L2 □
2:Plot2…
  Off  L1 L2 □
3:Plot3…
  Off  L1 L2 □
4:PlotsOff
5:PlotsOn
```

2nd [STAT PLOT]

(PRGM editor) PLOTS	(PRGM editor) TYPE	(PRGM editor) MARK
1:Plot1(	1:Scatter	1:□
2:Plot2(	2:xyLine	2:+
3:Plot3(	3:Boxplot	3:•
4:PlotsOff	4:Histogram	
5:PlotsOn		

STAT

EDIT	CALC
1:Edit…	1:1-Var Stats
2:SortA(	2:2-Var Stats
3:SortD(	3:SetUp…
4:ClrList	4:Med-Med
	5:LinReg(ax+b)
	6:QuadReg
	7:CubicReg
	8:QuartReg
	9:LinReg(a+bx)
	0:LnReg
	A:ExpReg
	B:PwrReg

STAT

```
(SetUp…)
1-Var Stats
Xlist: L1 L2 L3 L4 L5 L6
Freq:1 L1 L2 L3 L4 L5 L6
2-Var Stats
Xlist: L1 L2 L3 L4 L5 L6
Ylist: L1 L2 L3 L4 L5 L6
Freq:1 L1 L2 L3 L4 L5 L6
```

2nd [LIST]

OPS	MATH
1:SortA(	1:min(
2:SortD(	2:max(
3:dim	3:mean(
4:Fill(	4:median(
5:seq(	5:sum
	6:prod

MATH

MATH	NUM	HYP	PRB
1:▶Frac	1:round(	1:sinh	1:rand
2:▶Dec	2:iPart	2:cosh	2:nPr
3:^{3}	3:fPart	3:tanh	3:nCr
4:$\sqrt[3]{}$	4:int	4:sinh^{-1}	4:!
5:$\sqrt[x]{}$	5:min(	5:cosh^{-1}	
6:fMin(	6:max(	6:tanh^{-1}	
7:fMax(			
8:nDeriv(			
9:fnInt(			
0:solve(			

2nd [TEST]

TEST	LOGIC
1:=	1:and
2:≠	2:or
3:>	3:xor
4:≥	4:not
5:<	
6:≤	

MATRX

NAMES	MATH	EDIT
1:[A] *rxc*	1:det	1:[A] *rxc*
2:[B] *rxc*	2:^{T}	2:[B] *rxc*
3:[C] *rxc*	3:dim	3:[C] *rxc*
4:[D] *rxc*	4:Fill(	4:[D] *rxc*
5:[E] *rxc*	5:identity	5:[E] *rxc*
	6:randM(	
	7:augment(	
	8:rowSwap(	
	9:row+(	
	0:*row(	
	A:*row+(	

2nd [ANGLE]

ANGLE
1:°
2:'
3:r
4:▶DMS
5:R▶Pr(
6:R▶Pθ(
7:P▶Rx(
8:P▶Ry(

PRGM

EDIT	EDIT
1:*name*	1:*name*
2:*name*	2:*name*
3:*name*	3:*name*
...	...

PRGM

(PRGM editor)	(PRGM editor)
CTL	I/O
1:If	1:Input
2:Then	2:Prompt
3:Else	3:Disp
4:For(	4:DispGraph
5:While	5:DispTable
6:Repeat	6:Output(
7:End	7:getKey
8:Pause	8:ClrHome
9:Lbl	9:ClrTable
0:Goto	0:PrintScree
A:IS>(	A:Get(
B:DS<(	B:Send(
C:Menu(	
D:prgm	
E:Return	
F:Stop	

2nd [DRAW]

DRAW	POINTS
1:ClrDraw	1:Pt-On(
2:Line(	2:Pt-Off(
3:Horizontal	3:Pt-Change(
4:Vertical	4:Pxl-On(
5:Tangent(	5:Pxl-Off(
6:DrawF	6:Pxl-Change
7:Shade(	7:pxl-Test(
8:DrawInv	
9:Circle(	
0:Text(	
A:Pen	

PRB
1:rand
2:nPr
3:nCr
4:!

2nd [ANGLE]

ANGLE
1:°
2:'
3:r
4:▶DMS
5:R▶Pr(
6:R▶Pθ(
7:P▶Rx(
8:P▶Ry(

PRGM

EDIT	EDIT	New
1:*name*	1:*name*	1:Create New
2:*name*	2:*name*	
3:*name*	3:*name*	
...	...	

PRGM

(PRGM editor)	(PRGM editor)	(PRGM editor)
CTL	I/O	EXEC
1:If	1:Input	1:*name*
2:Then	2:Prompt	2:*name*
3:Else	3:Disp	3:*name*
4:For(	4:DispGraph	...
5:While	5:DispTable	
6:Repeat	6:Output(	
7:End	7:getKey	
8:Pause	8:ClrHome	
9:Lbl	9:ClrTable	
0:Goto	0:PrintScreen	
A:IS>(	A:Get(	
B:DS<(	B:Send(	
C:Menu(		
D:prgm		
E:Return		
F:Stop		

2nd [DRAW]

DRAW	POINTS	STO
1:ClrDraw	1:Pt-On(	1:StorePic
2:Line(	2:Pt-Off(	2:RecallPic
3:Horizontal	3:Pt-Change(	3:StoreGDB
4:Vertical	4:Pxl-On(	4:RecallGDB
5:Tangent(	5:Pxl-Off(	
6:DrawF	6:Pxl-Change(	
7:Shade(	7:pxl-Test(	
8:DrawInv		
9:Circle(		
0:Text(		
A:Pen		

VARS

```
VARS
1:Window...
2:Zoom...
3:GDB...
4:Picture...
5:Statistics...
6:Table...
```

VARS

(Window...)	(Window...)	(Window...)	(Zoom...)	(Zoom...)
X/Y	T/θ	U/V	ZX/ZY	ZT/Zθ
1:Xmin	1:Tmin	1:U*n*Start	1:ZXmin	1:ZTmin
2:Xmax	2:Tmax	2:V*n*Start	2:ZXmax	2:ZTmax
3:Xscl	3:Tscl	3:*n*Start	3:ZXscl	3:ZTscl
4:Ymin	4:θmin	4:*n*Min	4:ZYmin	4:Zθmin
5:Ymax	5:θmax	5:*n*Max	5:ZYmax	5:Zθmax
6:Yscl	6:θstep		6:ZYscl	6:Zθstep
7:ΔX				
8:ΔY				
9:XFact				
0:YFact				

(Zoom...)	(GDB...)	(Picture...)	(Statistics...)	(Statistics...)
ZU	GDB	PIC	X/Y	Σ
1:ZU*n*Start	1:GDB1	1:Pic1	1:n	1:Σx
2:ZV*n*Start	2:GDB2	2:Pic2	2:$\bar{x}$	2:Σx^2
3:Z*n*Start	3:GDB3	3:Pic3	3:Sx	3:Σy
4:Z*n*Min	4:GDB4	4:Pic4	4:σx	4:Σy^2
5:Z*n*Max	5:GDB5	5:Pic5	5:$\bar{y}$	5:Σxy
	6:GDB6	6:Pic6	6:Sy	
			7:σy	
			8:minX	
			9:maxX	
			0:minY	
			A:maxY	

(Statistics...)	(Statistics...)	(Statistics...)	(Table...)
EQ	BOX	PTS	TABLE
1:a	1:Q_1	1:x1	1:TblMin
2:b	2:Med	2:y1	2:ΔTbl
3:c	3:Q_3	3:x2	3:TblInput
4:d		4:y2	
5:e		5:x3	
6:r		6:y3	
7:RegEQ			

2nd [Y-VARS]

```
Y-Vars
1:Function...
2:Parametric...
3:Polar...
4:Sequence...
5:On/Off...
```

2nd [Y-VARS]

(Function...)	(Parametric...)
FUNCTION	PARAMETRIC
1:Y_1	1:X_{1T}
2:Y_2	2:Y_{1T}
3:Y_3	3:X_{2T}
4:Y_4	4:Y_{2T}
...	...
9:Y_9	A:X_{6T}
0:Y_0	B:Y_{6T}

2nd [MEM]

```
MEMORY
1:Check RAM...
2:Delete...
3:Reset...
```

2nd [MEM]

```
(Check RAM
MEM FREE 2
Real
List
Matrix
Y-Vars
Prgm
Pic
GDB
```

[2nd] [Y-VARS]

```
Y-Vars
1:Function…
2:Parametric…
3:Polar…
4:Sequence…
5:On/Off…
```

[2nd] [Y-VARS]

(Function…)	(Parametric…)	(Polar…)	(Sequence…)	(On/Off…)
FUNCTION	PARAMETRIC	1:r1=	SEQUENCE	ON/OFF
1:Y1	1:X1T	2:r2=	1:U*n*	1:FnOn
2:Y2	2:Y1T	3:r3=	2:V*n*	2:FnOff
3:Y3	3:X2T	4:r4=		
4:Y4	4:Y2T	5:r5=		
…	…	6:r6=		
9:Y9	A:X6T			
0:Y0	B:Y6T			

[2nd] [MEM]

```
MEMORY
1:Check RAM…
2:Delete…
3:Reset…
```

[2nd] [MEM]

(Check RAM…)		(Delete…)	(Reset…)
MEM FREE	28754	DELETE FROM…	RESET MEMORY
Real	15	1:All…	1:No
List	0	2:Real…	2:Reset
Matrix	0	3:List…	
Y-Vars	240	4:Matrix…	
Prgm	14	5:Y-Vars…	
Pic	0	6:Prgm…	
GDB	0	7:Pic…	
		8:GDB…	

…)

(Zoom…)	(Zoom…)
ZX/ZY	ZT/Zθ
1:ZXmin	1:ZTmin
2:ZXmax	2:ZTmax
3:ZXscl	3:ZTscl
4:ZYmin	4:Zθmin
5:ZYmax	5:Zθmax
6:ZYscl	6:Zθstep

(Statistics…)	(Statistics…)
X/Y	Σ
1:n	1:Σx
2:$\bar{x}$	2:Σx^2
3:Sx	3:Σy
4:σx	4:Σy^2
5:$\bar{y}$	5:Σxy
6:Sy	
7:σy	
8:minX	
9:maxX	
0:minY	
A:maxY	

Statistics…)	(Table…)
TS	TABLE
:x1	1:TblMin
:y1	2:ΔTbl
:x2	3:TblInput
:y2	
:x3	
:y3	

The variables listed below are used by the TI-82 in various ways. Some have restrictions on their use.

User Variables

The variables **A** through **Z** and θ are defined as real numbers. You may store to them. However, the TI-82 can update **X**, **Y**, **R**, θ, and **T** during graphing, so you may wish to avoid using these variables for nongraphing activities.

The variables **L1** through **L6** are defined as lists. You cannot store another type of data to them.

The variables **[A]**, **[B]**, **[C]**, **[D]**, and, **[E]** are defined as matrices. You cannot store another type of data to them.

The variables **Pic1** through **Pic6** are pictures. You cannot store another type of data to them.

The variables **GDB1** through **GDB6** are graph databases. You cannot store another type of data to them.

You can store any string of characters, functions, instructions, or variable names to the functions **Y***n*, **X***n*T, **r***n*, **U***n*, and **V***n* directly or through the Y= editor. The validity of the string is determined when the function is evaluated.

System Variables

The variables below must be real numbers. You may store to them. The TI-82 can update some of them, as the result of a ZOOM, for example, so you may wish to avoid using these variables for nongraphing activities.

- **Xmin**, **Xmax**, **Xscl**, **ΔX**, **XFact**, **Tstep**, **UStart**, ***n*Min**, and other WINDOW variables.
- **ZXmin**, **ZXmax**, **ZXscl**, **ZTstep**, **ZU*n*Start**, **Z*n*Min**, and other ZOOM MEMORY variables.

The variables below are reserved for use by the TI-82. You cannot store to them.

- **n**, $\bar{x}$, **minX**, Σx, **a**, **r**, **RegEQ**, **x1**, **y1**, and other statistical result variables.
- **Q1**, **Med**, **Q3**.

You can store to **U*n-1*** and **V*n-1*** outside of graphing, but you cannot store to ***n*** outside of graphing.

This appendc
may be help
procedures
calculator, a
provided by

Appendix Contents

Battery Info
In Case of D
Accuracy In
Error Condi
Service Info
One-Year Li

elow are used by the TI-82 in
ave restrictions on their use.

gh **Z** and θ are defined as real
re to them. However, the TI-82 can
T during graphing, so you may wish
ariables for nongraphing activities.

gh **L6** are defined as lists. You
type of data to them.

, [**C**], [**D**], and, [**E**] are defined as
store another type of data to them.

rough **Pic6** are pictures. You cannot
data to them.

hrough **GDB6** are graph databases.
ther type of data to them.

ing of characters, functions,
ble names to the functions **Y***n*, **X***n***T**,
ly or through the Y= editor. The
is determined when the function is

must be real numbers. You may store
an update some of them, as the result
ple, so you may wish to avoid using
ongraphing activities.

l, **ΔX**, **XFact**, **Tstep**, **UStart**, ***n*Min**, and
ariables.

Xscl, **ZTstep**, **ZU*n*Start**, **Z*n*Min**, and
ORY variables.

are reserved for use by the TI-82. You
n.

r, **RegEQ**, **x1**, **y1**, and other statistical

n-1 and **V***n-1* outside of graphing, but you
utside of graphing.

Appendix B: Reference Information

This appendix provides supplemental information that may be helpful as you use the TI-82. It includes procedures that may help you correct problems with the calculator, and it describes the service and warranty provided by Texas Instruments.

Appendix Contents

Battery Information B-2
In Case of Difficulty B-3
Accuracy Information B-4
Error Conditions B-5
Service Information B-10
One-Year Limited Warranty B-12

Battery Information

The TI-82 uses two types of batteries: four AAA alkaline batteries and a lithium battery as a backup for retaining memory while you change the AAA batteries.

When to Replace the Batteries

As the batteries run down, the display begins to dim (especially during calculations), and you must adjust the contrast to a higher setting. If you find it necessary to set the contrast to a setting of 8 or 9, you will need to replace the batteries soon. You should change the lithium battery every three or four years.

Effects of Replacing the Batteries

If you do not remove both types of batteries at the same time or allow them to run down completely, you can change either type of battery without losing anything in memory.

Replacing the Batteries

1. Turn the calculator off and replace the slide cover over the keys to avoid inadvertently turning on the calculator. Turn the calculator so that the back is facing you.
2. Holding the calculator upright, push the latch on the battery cover down with your fingernail or a paper clip and pull the cover out.
3. Replace all four AAA alkaline batteries or the lithium battery. **To avoid loss of information stored in memory, the calculator must be off; do not remove the AAA batteries and the lithium battery at the same time.**
   - To replace the AAA alkaline batteries, remove all four discharged AAA batteries and install new ones as shown on the polarity diagram located in the battery compartment.
   - To replace the lithium battery, remove the screw and clip holding the lithium battery. Install the new battery, + side up. Then replace the screw and clip. Use a CR1616 or CR1620 (or equivalent) lithium battery.

   Dispose of used batteries properly. Do not incinerate or leave within reach of small children.
4. Replace the cover. When you turn the calculator on, the display shows the Home screen as it was when you last used it.

In Case of Difficulty

If you have diffi following sugge problem.

Handling a Difficulty

1. If an error oc Refer to the errors begin
2. If you canno instructions
3. If the cursor Press 2nd [M memory.
4. If the dotted program is
5. If the calcul sure the bat are fresh.
6. If the difficu on contacti problem or

wo types of batteries: four AAA alkaline
thium battery as a backup for retaining
ou change the AAA batteries.

un down, the display begins to dim
g calculations), and you must adjust the
ner setting. If you find it necessary to set
setting of 8 or 9, you will need to replace
n. You should change the lithium battery
ur years.

ove both types of batteries at the same
m to run down completely, you can
e of battery without losing anything in

lator off and replace the slide cover over
oid inadvertently turning on the
rn the calculator so that the back is facing

alculator upright, push the latch on the
down with your fingernail or a paper clip
over out.

ur AAA alkaline batteries or the lithium
oid loss of information stored in
calculator must be off; do not remove
teries and the lithium battery at the

the AAA alkaline batteries, remove all
arged AAA batteries and install new ones
on the polarity diagram located in the
mpartment.

the lithium battery, remove the screw and
g the lithium battery. Install the new
side up. Then replace the screw and clip.
616 or CR1620 (or equivalent) lithium

ed batteries properly. Do not incinerate or
each of small children.

over. When you turn the calculator on, the
s the Home screen as it was when you last

In Case of Difficulty

If you have difficulty operating the calculator, the following suggestions may help you to correct the problem.

Handling a Difficulty

1. If an error occurs, follow the procedure on page 1-22. Refer to the more detailed explanations about specific errors beginning on page B-6, if necessary.
2. If you cannot see anything on the display, follow the instructions on page 1-3 to adjust the contrast.
3. If the cursor is a checker-board pattern, memory is full. Press [2nd] [MEM] **Delete...** and delete some items from memory.
4. If the dotted bar busy indicator is displayed, a graph or program is paused and the TI-82 is waiting for input.
5. If the calculator does not appear to be working at all, be sure the batteries are installed properly and that they are fresh.
6. If the difficulty persists, see page B-10 for information on contacting Consumer Relations to discuss the problem or obtain service.

Accuracy Information

To maximize accuracy, the TI-82 carries more digits internally than it displays.

Computational Accuracy

Values in memory are stored using up to 14 digits with a 2-digit exponent.

- You can store a value in the WINDOW variables using up to 10 digits (12 digits for **Xscl**, **Yscl**, **Tstep**, and **θstep**).
- When a value is displayed, the displayed value is rounded as specified by the MODE setting (Chapter 1), with a maximum of 10 digits and a 2-digit exponent.
- **RegEQ** displays up to 14 digits.

Graphing Accuracy

Xmin is the center of the leftmost pixel, **Xmax** is the center of the next to the rightmost pixel. (The rightmost pixel is reserved for the busy indicator.) **ΔX** is the distance between the centers of two adjacent pixels.

- **ΔX** is calculated as (**Xmax–Xmin**)/**94**.
- If **ΔX** is entered from the Home screen or a program, then **Xmax** is calculated as **Xmin**+**ΔX**∗**94**.

Ymin is the center of the next to the bottom pixel, **Ymax** is the center of the top pixel. **ΔY** is the distance between the centers of two adjacent pixels.

- **ΔY** is calculated as (**Ymax-Ymin**)/**62**.
- If **ΔY** is entered from the Home screen or a program, then **Ymax** is calculated as **Ymin**+**ΔY**∗**62**.

Cursor coordinates are displayed as eight characters (which may include a negative sign, decimal point, and exponent). The values of **X** and **Y** are updated with a maximum of eight-digit accuracy.

root, **minimum**, **maximum**, **intersect**, and **∫f(x)dx** on the CALCULATE menu are calculated with a tolerance of 1E-5. Therefore, the result displayed may not be accurate to all eight displayed digits. (In general, for most functions, there are at least 5 accurate digits.) The tolerance can be specified for the command-line functions **solve(**, **fMin(**, **fMax(**, and **fnInt(** on the MATH MATH menu.

Function Limits

Function
sin x, cos x,
arcsin x, arc
ln x, log x
e^x
10^x
sinh x, cosh
tanh x
$\sinh^{-1} x$
$\cosh^{-1} x$
$\tanh^{-1} x$
$\sqrt{x}$
$x!$

Function Results

Function
$\sin^{-1} x$, tan
$\cos^{-1} x$

curacy, the TI-82 carries more digits
t displays.

y are stored using up to 14 digits with a

e a value in the WINDOW variables using
s (12 digits for **Xscl**, **Yscl**, **Tstep**, and

e is displayed, the displayed value is
pecified by the MODE setting (Chapter 1),
ıum of 10 digits and a 2-digit exponent.
ays up to 14 digits.

er of the leftmost pixel, **Xmax** is the center
e rightmost pixel. (The rightmost pixel is
busy indicator.) **ΔX** is the distance
ters of two adjacent pixels.

ted as (**Xmax–Xmin**)/**94**.
ed from the Home screen or a program,
s calculated as **Xmin**+**ΔX**∗**94**.

er of the next to the bottom pixel, **Ymax** is
top pixel. **ΔY** is the distance between the
djacent pixels.

ted as (**Ymax-Ymin**)/**62**.
ed from the Home screen or a program,
s calculated as **Ymin**+**ΔY**∗**62**.

tes are displayed as eight characters
ude a negative sign, decimal point, and
values of **X** and **Y** are updated with a
ht-digit accuracy.

maximum, **intersect**, and **∫f(x)dx** on the
nu are calculated with a tolerance of 1E–5.
esult displayed may not be accurate to all
digits. (In general, for most functions, there
curate digits.) The tolerance can be
command-line functions **solve(**, **fMin(**,
(on the MATH MATH menu.

Function Limits

Function	Range of Input Values
sin x, **cos** x, **tan** x	$0 \le \lvert x \rvert < 10^{12}$ (radian or degree)
arcsin x, **arccos** x	$-1 \le x \le 1$
ln x, **log** x	$10^{-100} < x < 10^{100}$
$\mathbf{e}^x$	$-10^{100} < x \le 230.25850929940$
$\mathbf{10}^x$	$-10^{100} < x < 100$
sinh x, **cosh** x	$\lvert x \rvert \le 230.25850929940$
tanh x	$\lvert x \rvert < 10^{100}$
$\mathbf{sinh}^{-1}\ x$	$\lvert x \rvert < 5 \times 10^{99}$
$\mathbf{cosh}^{-1}\ x$	$1 \le x < 5 \times 10^{99}$
$\mathbf{tanh}^{-1}\ x$	$-1 < x < 1$
$\sqrt{x}$	$0 \le x < 10^{100}$
$x!$	$0 \le x \le 69$, where x is an integer

Function Results

Function	Range of Result
$\mathbf{sin}^{-1}\ x$, $\mathbf{tan}^{-1}\ x$	-90° to 90° or $-\pi/2$ to $\pi/2$ (radians)
$\mathbf{cos}^{-1}\ x$	0° to 180° or 0 to π (radians)

When the TI-82 detects an error, it displays ERR:*message* and the error menu. The general procedure for correcting errors is described on page 1-22. Each error type, including possible causes and suggestions for correction, are shown below.

ARGUMENT	A function or instruction does not have the correct number of arguments. See Appendix A and the appropriate chapter.
BAD GUESS	• For a CALC operation, Guess must be between Lower Bound and Upper Bound. • For the **solve(** function, *guess* must be between *lower* and *upper*. • The guess and several points around it are undefined. Examine a graph of the function. If the equation has a solution, change the bounds and/or the initial guess.
BOUND	• For a CALC operation , you must define Lower Bound < Upper Bound. • For **fMin(**, **fMax(**, **fnInt(**, and **solve(**, *lower* must be less than *upper*.
BREAK	You have pressed the [ON] key to break execution of a program, halt a DRAW instruction, or stop evaluaton of an expression.
DATA TYPE	You have entered a value or variable that is the wrong data type. • A function (including implied multiplication) or an instruction has an argument that is an invalid data type; for example, a list where a real number is required. See Appendix A and the appropriate chapter. • In an editor, you have entered a type that is not allowed; for example, a matrix as an element in the STAT list editor. See the appropriate chapter. • You are attempting to store to an incorrect data type; for example, a matrix to a list.
DIM MISMATCH	You are attempting to perform an operation that has more than one list or matrix, but the dimensions do not match.

DIVIDE BY 0	• You are a not occu undefine • You are a line.
DOMAIN	• The argu valid ran chapter. The TI-8 • You are a with a -X
Duplicate Name	Unable to tr already exis
Error in Xmit	• Unable t firmly co unit is in • [ON] was
ILLEGAL NEST	You are atte argument to *expression*
INCREMENT	• The incr error do for unde • The incr
INVALID	You are atte function in **Y*n*** cannot r
INVALID DIM	• The dim the oper • Matrix e dimensi • A matri

DIVIDE BY 0	• You are attempting to divide by zero. This error does not occur during graphing. The TI-82 allows for undefined values on a graph. • You are attempting a linear regression with a vertical line.
DOMAIN	• The argument to a function or instruction is out of the valid range. See Appendix A and the appropriate chapter. This error does not occur during graphing. The TI-82 allows for undefined values on a graph. • You are attempting a logarithmic or power regression with a **-X** or an exponential regression with a **-Y**.
Duplicate Name	Unable to transmit item because a variable with that name already exists in receiving unit.
Error in Xmit	• Unable to transmit item. Check to see that the cable is firmly connected to both units and that the receiving unit is in Receive mode. • [ON] was used to break during transmission.
ILLEGAL NEST	You are attempting to use an invalid function in an argument to a function; for example, **seq(** within *expression* for **seq(**.
INCREMENT	• The increment in **seq(** is **0** or has the wrong sign. This error does not occur during graphing. The TI-82 allows for undefined values on a graph. • The increment for a loop is **0**.
INVALID	You are attempting to reference a variable or use a function in a place where it is not valid. For example, **Y*n*** cannot reference **Y**, **Xmin**, **ΔX** or **TblMin**.
INVALID DIM	• The dimension of the argument is not appropriate for the operation. • Matrix element dimensions and list element dimensions must be integers between 1 and 99. • A matrix must be square to invert it.

ITERATIONS	**solve(** has exceeded the maximum number of iterations permitted. Examine a graph of the function. If the equation has a solution, change the bounds and/or the initial guess.
LABEL	The label in the **Goto** instruction is not defined with a **Lbl** instruction in the program.
MEMORY	There is insufficient memory in which to perform the desired command. You must delete item(s) from memory (Chapter 15) before executing this command.
Memory Full	Unable to transmit item because there is insufficient available memory in the receiving unit. You may skip the item or exit Receive mode. During a memory backup, the receiving unit does not have enough memory to receive all items in memory in the sending unit. A message indicates the number of bytes the sending unit must delete to do the memory backup. Delete items and try again.
MODE	You are attempting to store to a WINDOW variable in another graphing MODE or to perform an instruction while in the wrong MODE, such as **DrawInv** in a graphing MODE other than **Func**.
NO SIGN CHNG	The **solve(** function did not detect a sign change. Examine a graph of the function. If the equation has a solution, change the bounds and/or the initial guess.
OVERFLOW	You are attempting to enter, or have calculated, a number that is beyond the range of the calculator. This error does not occur during graphing. The TI-82 allows for undefined values on a graph.
RESERVED	You are attempting to use a system variable inappropriately. See Appendix A.
SINGULAR MAT	• A singular matrix (determinate = 0) is not valid as the argument for $^{-1}$. • You are attempting a polynomial regression with lists that are not appropriate This error does not occur during graphing. The TI-82 allows for undefined values on a graph.

SINGULARITY	*expression* in the **solve(** function contains a singularity (a point at which the function is not defined). Examine a graph of the function. If the equation has a solution, change the bounds and/or the initial guess.
STAT	You are attempting a stat calculation with lists that are not appropriate. • Statistical analyses must have at least two data points. • **Med-Med** must have at least three points in each partition. • Freq, when used, must be an integer ≥ **0**. • **(Xmax-Xmin)/Xscl** must be ≤ 47 for a histogram.
STAT PLOT	You are trying to display a graph when there is a StatPlot On that uses an undefined list.
SYNTAX	The command contains a syntax error. Look for misplaced functions, arguments, parentheses, or commas. See Appendix A and the appropriate chapter.
TOL NOT MET	The algorithm cannot return a result accurate to the requested tolerance.
UNDEFINED	You are referencing a variable that is not currently defined; for example, a stat variable when there is no current calculation because a list has been edited or when the variable is not valid for the current calculation, such as **a** after **Med-Med**.
WINDOW RANGE	There is a problem with the WINDOW variables. • You may have defined **Xmax≤Xmin**, **Ymax≤Ymin**, **θmax≤θmin** and **θstep>0** (or vice versa), **Tstep=0**, or **Tmax≤Tmin** and **Tstep>0** (or vice versa). • WINDOW variables are too small or too large to graph correctly, which can occur if you attempt to zoom in or out so far that you are not within the numerical range of the calculator.
ZOOM	A point or a line, rather than a box, is defined in **ZBox** or a math error resulted from a ZOOM operation.

Service Information

If the solutions suggested by "In Case of Difficulty" do not correct a problem you may have with your TI-82, you may call or write Texas Instruments Consumer Relations.

For Service and General Information

If you have questions about service or about the general use of the TI-82, call Consumer Relations toll-free at:

1-800-TI-CARES (1-800-842-2737)

You may also write to:

Consumer Relations
Texas Instruments Incorporated
P.O. Box 53
Lubbock, Texas 79408-0053

Please contact Consumer Relations:

- Before returning the product for service.
- For information on our express service option for fast return delivery.
- For general information about using the TI-82.
- For information about purchasing related products.

For Technical Information

If you have technical questions about the TI-82 or programming applications, you may call the Technical Support Group of Consumer Relations at:

1-806-741-2663

Please note that this is a toll number, and collect calls are not accepted.

You may also write to:

Technical Support Group, Consumer Relations
Texas Instruments Incorporated
P.O. Box 53
Lubbock, Texas 79408-0053

Returning Your Calculator for Service

A defective c
with the sam
option) wher
Instruments

Texas Instru
damage duri
carefully pac
with the carr
with your cal

- Your full
- Any acces
- A note de
- A copy of
to determ

Please ship t
cannot be ac

In-Warranty Service

For a calcula
charge is ma

Out-of-Warranty Service

A flat-rate ch
service. To o
model, conta
product for s
Service Faci

Texas Instruments Service Facilities

U.S. Reside
(U.S. Posta
Texas Instru
P.O. Box 25
Lubbock, Te

Canadian R
Texas Instru
41 Shelley R
Richmond H

ted by "In Case of Difficulty" do
ou may have with your TI-82, you
Instruments Consumer Relations.

out service or about the general
nsumer Relations toll-free at:

00-842-2737)

corporated

8-0053

er Relations:

product for service.

our express service option for fast

tion about using the TI-82.

ut purchasing related products.

estions about the TI-82 or
ns, you may call the Technical
umer Relations at:

a toll number, and collect calls are

roup, Consumer Relations
corporated

8-0053

Returning Your Calculator for Service

A defective calculator will be either repaired or replaced with the same or comparable reconditioned model (at TI's option) when it is returned, postage prepaid, to a Texas Instruments Service Facility.

Texas Instruments cannot assume responsibility for loss or damage during incoming shipment. For your protection, carefully package the calculator for shipment and insure it with the carrier. Be sure to enclose the following items with your calculator:

- Your full return address and daytime phone number
- Any accessories related to the problem
- A note describing the problem you experienced
- A copy of your sales receipt or other proof of purchase to determine warranty status

Please ship the calculator postage prepaid; COD shipments cannot be accepted.

In-Warranty Service

For a calculator covered under the warranty period, no charge is made for service.

Out-of-Warranty Service

A flat-rate charge by model is made for out-of-warranty service. To obtain the service charge for a particular model, contact Consumer Relations before returning the product for service. (We cannot hold products in the Service Facility while providing charge information.)

Texas Instruments Service Facilities

U.S. Residents (U.S. Postal Service)
Texas Instruments
P.O. Box 2500
Lubbock, Texas 79408

U.S. Residents (other carriers)
Texas Instruments
2305 N. University
Lubbock, Texas 79408

Canadian Residents Only
Texas Instruments
41 Shelley Road
Richmond Hill, Ontario L4C 5G4

One-Year Limited Warranty

This Texas Instruments electronic calculator warranty extends to the original consumer purchaser of the product.

Warranty Duration

This calculator is warranted to the original consumer purchaser for a period of one (1) year from the original purchase date.

Warranty Coverage

This calculator is warranted against defective materials or workmanship. **This warranty is void if the product has been damaged by accident, unreasonable use, neglect, improper service, or other causes not arising out of defects in material or workmanship.**

Warranty Disclaimers

Any implied warranties arising out of this sale, including but not limited to the implied warranties of merchantability and fitness for a particular purpose, are limited in duration to the above one-year period. Texas Instruments shall not be liable for loss of use of the calculator or other incidental or consequential costs, expenses, or damages incurred by the consumer or any other user.

Some states do not allow the exclusion or limitations of implied warranties or consequential damages, so the above limitations or exclusions may not apply to you.

Legal Remedies

This warranty gives you specific legal rights, and you may also have other rights that vary from state to state.

Warranty Performance

During the above one-year warranty period, a defective TI calculator will either be repaired or replaced with a reconditioned comparable model (at TI's option) when the product is returned, postage prepaid, to a Texas Instruments Service Facility.

The repaired or replacement calculator will be in warranty for the remainder of the original warranty period or for six months, whichever is longer. Other than the postage requirement, no charge will be made for such repair or replacement.

Texas Instruments strongly recommends that you insure the product for value prior to mailing.

Index

- A -

a variable, 12-14 to 12-16, A-2
[**A**] matrix, 10-4, 10-8, 10-9, A-
abs, 2-4, 10-10, A-2
Absolute value, 2-4, 10-10, A-
Accuracy, 3-13, B-4, B-5
Addition: **+**, 2-3, 10-10, A-2
ALPHA, ALPHA-LOCK, 1-8
and, 2-16, A-2
Angle entry indicators (°, ʳ, ʰ)
ANGLE menu, 2-13, 2-14
Angle MODE, 1-11
Ans, 1-16, 13-4
Antilogs, 2-4
APD, 1-2
Applications
  Area between curves, 14
  Box with lid, GS-6 to GS
  Building height, 12-2 to
  Buying a car, 14-5
  Cobweb, 14-9
  Compound interest, GS-
    GS-5, 14-5
  Family of curves, 13-2,
  Ferris wheel, 14-12, 14-
  Forest and trees, 6-2
  Fundamental theorem o
    calculus, 14-18, 14-
  Generating a sequence,
  Graphing a circle, 3-2
  Graphing inequalities, 1
  Guess the coefficients,
  Left-brain, right-brain te
    results, 14-2, 14-3
  Lottery chances, 2-2
  Path of a ball, 4-2
  Polar rose, 5-2
  Polynomial coefficients
  Predator-prey, 14-16, 14
  Reservoir, 14-14, 14-15
  Roots of a function, 7-6
  Sending variables, 16-2
  Shading a graph, 8-2
  Sierpinski triangle, 14-
  Systems of linear equat
    10-2, 10-3

nents electronic calculator warranty
ginal consumer purchaser of the

warranted to the original consumer
riod of one (1) year from the original

warranted against defective materials or
is warranty is void if the product has
y accident, unreasonable use,
er service, or other causes not arising
material or workmanship.

ranties arising out of this sale,
t limited to the implied warranties
ity and fitness for a particular
ited in duration to the above one-
as Instruments shall not be liable
f the calculator or other incidental or
osts, expenses, or damages incurred
r or any other user.

ot allow the exclusion or limitations of
s or consequential damages, so the above
lusions may not apply to you.

es you specific legal rights, and you may
ghts that vary from state to state.

one-year warranty period, a defective TI
her be repaired or replaced with a
mparable model (at TI's option) when the
ed, postage prepaid, to a Texas
ice Facility.

eplacement calculator will be in warranty
r of the original warranty period or for six
er is longer. Other than the postage
charge will be made for such repair or

ts strongly recommends that you insure
alue prior to mailing.

Index

- A -

a variable, 12-14 to 12-16, A-28
[**A**] matrix, 10-4, 10-8, 10-9, A-28
abs, 2-4, 10-10, A-2
Absolute value, 2-4, 10-10, A-2
Accuracy, 3-13, B-4, B-5
Addition: **+**, 2-3, 10-10, A-2
ALPHA, ALPHA-LOCK, 1-8
and, 2-16, A-2
Angle entry indicators (°, ʳ, ᴵ), 2-13
ANGLE menu, 2-13, 2-14
Angle MODE, 1-11
Ans, 1-16, 13-4
Antilogs, 2-4
APD, 1-2
Applications
  Area between curves, 14-20
  Box with lid, GS-6 to GS-13
  Building height, 12-2 to 12-8
  Buying a car, 14-5
  Cobweb, 14-9
  Compound interest, GS-4 to GS-5, 14-5
  Family of curves, 13-2, 13-3
  Ferris wheel, 14-12, 14-13
  Forest and trees, 6-2
  Fundamental theorem of calculus, 14-18, 14-19
  Generating a sequence, 11-2
  Graphing a circle, 3-2
  Graphing inequalities, 14-6
  Guess the coefficients, 14-10
  Left-brain, right-brain test results, 14-2, 14-3
  Lottery chances, 2-2
  Path of a ball, 4-2
  Polar rose, 5-2
  Polynomial coefficients, 9-2
  Predator-prey, 14-16, 14-17
  Reservoir, 14-14, 14-15
  Roots of a function, 7-6
  Sending variables, 16-2
  Shading a graph, 8-2
  Sierpinski triangle, 14-8
  Systems of linear equations, 10-2, 10-3

- A (Cont.) -

Applications (Cont.)
  Systems of nonlinear equations, 14-7
  Speeding tickets, 14-4
  Unit circle and trig curves, 14-11
Arcsine, arcosine, arctangent. *See* **sin⁻¹, cos⁻¹, tan⁻¹**
ARGUMENT error, B-6
Arrow keys, 1-8
augment(, 10-12, 10-14, A-2
Automatic Power Down, 1-2
Axes (graphing), 3-10
AxesOff, **AxesOn** FORMAT, 3-10, A-2

- B -

b variable, 12-14 to 12-16, A-28
[**B**] matrix, 10-4, 10-8, 10-9, A-28
Backup, 16-8
BAD GUESS error, B-6
Batteries, B-2
Boolean operators, 2-16
BOUND error, B-6
Bounding a solution, 2-8, 3-23
BOX (VARS) menu, 1-19, 12-14
Box plot, 12-19 to 12-22
Break, 1-7, 13-4, B-6
BREAK error, B-6
Busy indicator, 1-5, B-3

- C -

c variable, 12-14 to 12-16, A-28
[**C**] matrix, 10-4, 10-8, 10-9, A-28
Cable, 16-3
CALC, CALCULATE, GS-13, 3-21 to 3-24, 4-6, 5-6, 6-6, 9-3
CALC menu, 3-21 to 3-24
Calculus, 2-7, 3-24
Calling other programs, 13-11, 13-18
Cancelling a menu, GS-2, 1-17
Check Ram screen, 15-2
Circle(, 8-3, 8-9, A-2
Circles, 3-2, 8-9
Clearing, 1-8
  cursor coordinates, 3-13

- C (Cont.) -

Clearing (Cont.)
display, 1-8
drawing, 8-16
expression, 1-8
Home screen, 1-8
list, 12-10 to 12-12
matrix, 10-6, 10-7
menu, GS-2, 1-17
table, 7-6
ClrDraw, 3-24, 8-3, 8-16, A-2
ClrHome, 13-13, 13-15, 13-17, A-3
ClrList, 12-12, A-3
ClrTable, 7-6, 13-13, 13-17, A-3
Cobweb graph. *See* **Web**
Coefficients (regression equation), 12-13 to 12-15
Combinations (probability), 2-12
Commands, 1-6, 13-4 to 13-6
Communications, 16-1 to 16-8
Compare, 2-16
Concatenating commands, 1-6, 1-14
Connected MODE, 1-9, 1-11, 3-4, A-3
Contrast setting, GS-3, 1-3
Conversions
fractions, 2-5, 11-2, A-8
polar to rectangular, 2-13, 2-14, A-15
rectangular to polar, 2-13, 2-14, A-17
Coordinates, 3-10
CoordOff, **CoordOn** FORMAT, 3-10, A-3
Correlation coefficient **r**, 12-14, 12-15, A-28
cos, **cos^{-1}**, 2-3, A-3, B-5
Cosine, 2-3, A-3, B-5
cosh, **cosh^{-1}**, 2-11, A-3, B-5
CTL (PRGM) menu, 13-7 to 13-12
Cube: **^{3}**, 2-5, 2-6, 10-11, A-3
Cube root: **$\sqrt[3]{}$**, 2-5, 2-6, A-3
CubicReg, 12-13, 12-15, A-4
Cubic fit/regression, 12-15
Cursor coordinates, 3-10
Cursor keys, 1-8
Cursors, 1-5, 1-8, B-3
Curve fitting, 12-4 to 12-8

- D -

d variable, 12-14, 12-15, A-28
[**D**] matrix, 10-4, 10-8, 10-9, A-28
DATA TYPE error, B-6
▶**Dec**, 2-5, A-4
Decimal display, 1-10, 2-5, A-4
Decimal WINDOW, 3-16, 3-18, A-21
Decrement and skip, 13-10
Definite integral, 2-5, 2-7, A-7, B-4, B-6
Degree/minute/second, 2-13, 2-14, A-5
Degree MODE, 1-9, 1-11, 2-13, 3-4, A-4
Degree notation °, 2-13, A-4
Deleting, 1-8, 15-3
ΔTbl variable, 7-2, 7-3, 7-6
ΔX, **ΔY**, 3-9, 3-18, A-28, B-4
DependAsk, 7-3, 7-5, A-4
DependAuto, 7-3, 7-5, A-4
Dependent variable, 7-3 to 7-5
Derivative. *See* Numerical derivative
det, 10-12, A-4
Determinate, 10-12, A-4
Differentiation, 2-5, 2-6, 3-21, 3-24, 4-6, 5-6, A-12
dim, 10-12, 10-13, 11-6, 11-7, A-4
Dimension (list), 11-6, 11-7, A-4
Dimension (matrix), 10-4 to 10-6, 10-12, 10-13, A-4
DIM MISMATCH error, B-6
Disp, 13-10, 13-13, 13-14, A-4
DispGraph, 12-22, 13-10, 13-13, 13-15, A-4
Display, 1-3 to 1-4
contrast, GS-3, 1-3, B-3
cursors, 1-5, 1-8, B-3
decimal, 2-5, A-4
DMS, 2-13, 2-14, A-5
fraction, 2-5, 11-2, A-8
graph, 3-11, 3-12
Home screen, 1-4
text, 8-3, 8-10, 9-4, 13-13, 13-15, A-13, A-20
DispTable, 13-10, 13-13, 13-15, A-4
DIVIDE BY 0 error, B-7
Division: /, 2-3, A-5

- D (Cont.) -

▶**DMS**, 2-13, 2-14, A-5
DOMAIN error, B-7
Dot MODE, 1-9, 1-11, 3-4, A-
DRAW menu, 8-3 to 8-11
Drawing
DrawF, 8-7, A-5
function, 8-7
inverse function, 8-7
lines, 8-4 to 8-6
on a graph, 8-1 to 8-16
pixels, 8-13
points, 8-12
stat data, 12-6 to 12-8, 12-22
tangents, 8-6
DrawInv, 8-7, A-5, B-8
DS<(, 13-7, 13-10, A-5
Duplicate Name message, 1
dy/dx, **dy/dt**, **dx/dt**, **dr/dθ**, 3 4-6, 5-6

- E -

ε, 2-7, 3-24
e variable, 12-14, 12-15, A-
[**E**] matrix, 10-4, 10-8, 10-9
e^, 2-4, A-5, B-5
e (natural log), 2-4
Edit keys, 1-8
Editors, 1-8, 9-3
function, 3-5, 3-6, 4-3
list, 9-3, 12-9 to 12-11
matrix, 10-4 to 10-6
program, 9-3
statistics, 9-3
table, 9-3
Y=, 9-3
Element
list, 11-3 to 11-5
matrix, 10-4 to 10-9
sequence, 6-5
Else, 13-7 to 13-9, A-5
End, 13-7 to 13-9, A-5
Eng MODE, 1-9, 1-10, A-
Engineering display, 1-9,

- D -

d variable, 12-14, 12-15, A-28
[D] matrix, 10-4, 10-8, 10-9, A-28
DATA TYPE error, B-6
▸Dec, 2-5, A-4
Decimal display, 1-10, 2-5, A-4
Decimal WINDOW, 3-16, 3-18, A-21
Decrement and skip, 13-10
Definite integral, 2-5, 2-7, A-7, B-4, B-6
Degree/minute/second, 2-13, 2-14, A-5
Degree MODE, 1-9, 1-11, 2-13, 3-4, A-4
Degree notation °, 2-13, A-4
Deleting, 1-8, 15-3
ΔTbl variable, 7-2, 7-3, 7-6
ΔX, ΔY, 3-9, 3-18, A-28, B-4
DependAsk, 7-3, 7-5, A-4
DependAuto, 7-3, 7-5, A-4
Dependent variable, 7-3 to 7-5
Derivative. *See* Numerical derivative
det, 10-12, A-4
Determinate, 10-12, A-4
Differentiation, 2-5, 2-6, 3-21, 3-24, 4-6, 5-6, A-12
dim, 10-12, 10-13, 11-6, 11-7, A-4
Dimension (list), 11-6, 11-7, A-4
Dimension (matrix), 10-4 to 10-6, 10-12, 10-13, A-4
DIM MISMATCH error, B-6
Disp, 13-10, 13-13, 13-14, A-4
DispGraph, 12-22, 13-10, 13-13, 13-15, A-4
Display, 1-3 to 1-4
  contrast, GS-3, 1-3, B-3
  cursors, 1-5, 1-8, B-3
  decimal, 2-5, A-4
  DMS, 2-13, 2-14, A-5
  fraction, 2-5, 11-2, A-8
  graph, 3-11, 3-12
  Home screen, 1-4
  text, 8-3, 8-10, 9-4, 13-13, 13-15, A-13, A-20
DispTable, 13-10, 13-13, 13-15, A-4
DIVIDE BY 0 error, B-7
Division: /, 2-3, A-5

- D (Cont.) -

▸DMS, 2-13, 2-14, A-5
DOMAIN error, B-7
Dot MODE, 1-9, 1-11, 3-4, A-5
DRAW menu, 8-3 to 8-11
Drawing
DrawF, 8-7, A-5
  function, 8-7
  inverse function, 8-7
  lines, 8-4 to 8-6
  on a graph, 8-1 to 8-16
  pixels, 8-13
  points, 8-12
  stat data, 12-6 to 12-8, 12-18 to 12-22
  tangents, 8-6
DrawInv, 8-7, A-5, B-8
DS<(, 13-7, 13-10, A-5
Duplicate Name message, 16-7, B-7
dy/dx, dy/dt, dx/dt, dr/dθ, 3-21, 3-24, 4-6, 5-6

- E -

ε, 2-7, 3-24
e variable, 12-14, 12-15, A-28
[E] matrix, 10-4, 10-8, 10-9, A-28
e^, 2-4, A-5, B-5
e (natural log), 2-4
Edit keys, 1-8
Editors, 1-8, 9-3
  function, 3-5, 3-6, 4-3, 5-3, 6-3
  list, 9-3, 12-9 to 12-11
  matrix, 10-4 to 10-6
  program, 9-3
  statistics, 9-3
  table, 9-3
  Y=, 9-3
Element
  list, 11-3 to 11-5
  matrix, 10-4 to 10-9
  sequence, 6-5
Else, 13-7 to 13-9, A-5
End, 13-7 to 13-9, A-5
Eng MODE, 1-9, 1-10, A-5
Engineering display, 1-9, 1-10, A-5

- E (Cont.) -

Entering
  expressions, 1-6
  functions, 1-7, 1-19, 3-5 to 3-7, 4-3, 5-3, 6-3, 7-4, A-28
  lists, 11-2 to 11-5, 12-10 to 12-12
  matrices, 10-4 to 10-9
  negative numbers, 1-21, 2-4, 10-10, A-12
  programs, 13-4 to 13-6
  statistics, 9-3, 12-2, 12-9
EOS, 1-20, 1-21, 2-15
EQ (VARS) menu, 1-19, 12-14
Equal: =, 2-15, 10-11, A-5
Equation Operating System, 1-20, 1-21, 2-15
Equations, parametric, 4-2 to 4-6
Equations, solving, 2-5, 2-8, 3-22, A-18, A-19, B-4, B-6, B-8, B-9
Erasing a program, 13-6, 15-3
Error in Xmit message, B-7
Errors, 1-22, 11-5, 13-4, 16-6, B-3 to B-9
Evaluating expressions, 1-6
Evaluating functions, 3-21
Exclusive or, 2-16, A-21
Executing programs, 13-5
Exponent: E, 1-7, A-6
Exponential regression, 12-13, 12-16, A-6
ExpReg, 12-13, 12-16, A-6
Expressions, x, 1-6

- F -

∫f(x)dx, 3-21, 3-24, B-4
Factorial: **!**, 2-12, A-6, B-5
Family of curves, 3-12, 13-2, 13-3
Fill(, 10-13, 11-6, 11-8, A-6
Fix MODE, 1-9, 1-10, A-6
Float MODE, 1-9, 1-10, A-6
fMax(, 2-5, 2-6, A-6, B-4, B-6
fMin(, 2-5, 2-6, A-7, B-4, B-6
fnInt(, 2-5, 2-7, A-7, B-4, B-6
FnOff, FnOn, 3-7, A-7

- F (Cont.) -

For(, 13-7 to 13-9, A-7
FORMAT. *See* WINDOW
fPart, 2-9, 10-11, A-7, A-8
Fractional part, 2-9, 10-11, A-7, A-8
Fractions, 2-5
▶Frac, 2-5, 11-2, A-8
Free-moving cursor, 3-13, 4-6, 5-6, 6-4
Freq (frequency), 12-20
Friendly WINDOW (**ZDecimal**), 3-16, 3-18, A-21
FullScreen, 1-9, 1-11, 9-4, A-8
Func MODE, 1-9, 1-11, 3-4, 8-7, A-8
Functions, x, 1-6, 1-7
  defining, 3-5, 3-6, 4-3
  evaluating, 3-6, 3-21
  graphing, 3-1 to 3-22
  integral, 2-5, 2-7, 3-21, 3-24, A-7, B-4, B-6
  maximum, 2-5, 2-6, A-6, B-4, B-6
  minimum, 2-5, 2-6, A-7, B-4, B-6
  parametric, 4-2 to 4-4
  polar, 5-2 to 5-4
  sequence, 6-2 to 6-4
  selecting, 3-7, 4-3, 5-3, 6-4

- G -

GDB*n* variables, 1-19, A-28
Get(, 13-13, 13-17, A-8
getKey, 13-13, 13-16, A-8
Getting Started. *See* Applications
Glossary, x
Goto, 13-7, 13-10, A-8, B-8
Graph
  accuracy, 3-11
  database, 1-19, 8-15
  defining, 3-3, 4-3, 5-3, 6-3
  displaying, 3-11, 3-12, 4-3, 5-3, 6-3, 9-3
  FORMAT, 3-10, 9-3
  MODE, 1-10
  parametric, 4-1 to 4-6
  picture, 8-14

- G (Cont.) -

Graph (continued)
  polar, 5-1 to 5-6
  sequence, 6-1 to 6-6
Greater than: **>**, 2-15, A-8
Greater than or equal: ≥, 2-15, A-8
Greatest integer, 2-9, 2-10, 10-11
GridOff, **GridOn** FORMAT, 3-10, A-8
Guess, 2-8, 3-22, 3-23, B-6
Guidebook, using, viii, ix

- H -

Histogram, 12-19 to 12-22, B-9
Home screen, x, 1-4, 9-3
Horizontal, 8-3, 8-5, A-8
Horizontal line, 8-5
HYP (MATH) menu, 2-11
Hyperbolic functions, 2-11
Hyperbolic arcsine, arcosine, arctangent. *See* **sinh^{-1}**, **cosh^{-1}**, **tanh^{-1}**

- I -

identity (matrix), 10-12, 10-13, A-8
If, 13-7, 13-8, A-9
ILLEGAL NEST error, B-7
Implied multiplication, 1-21
Increment and skip, 13-10
INCREMENT error, B-7
Independent variable, 3-5, 7-3, 7-5
IndpntAsk, 7-3, 7-5, A-9
IndpntAuto, 7-3, 7-5, A-9
Input, 13-13, A-9
Input to programs, 13-13 to 13-17
INPUT/OUTPUT, 13-13 to 13-17
Inserting, 1-8
Instructions, x, 1-6, 1-7
int, 2-9, 2-10, 10-11, A-9
Integer part, 2-9, 2-10, 10-11, A-9
Integrals, 2-5, 2-7, 3-21, 3-24, A-7, B-4, B-6
Intercepts, 3-21, 3-22, B-4
intersect, 3-21, 3-23, B-4
Intersection, 3-21, 3-23, B-4
Interrupt, 1-7, 13-4
INVALID error, B-7
INVALID DIM error, B-7

- I (Cont.) -

Inverse: **$^{-1}$**, 2-3, 10-11, A-9
  hyperbolics, 2-11
  functions, 8-3, A-5, B-8
  logs, 2-4
  matrices, 10-11
  trigs, 2-3
iPart, 2-9, 2-10, 10-11, A-9
IS>(, 13-7, 13-10, A-9
ITERATIONS error, B-8

- L -

L*n* (lists), 11-2 to 11-5, A-28
LABEL error, B-8
LabelOff, **LabelOn**, 3-10, A-1
Labels (graph), 3-10, A-10
Labels (program), 13-10
Last Answer, 1-16, 13-4
Last Entry, 1-14, 1-15, 13-4
Lbl, 13-7, 13-10, A-10, B-8
Less than: **<**, 2-15, A-10
Less than or equal: ≤, 2-15, A
Line(, 8-3, 8-4, A-10
Line (stat), 12-18, 12-20 to 12
Linear regression, 12-15, 12-
LINK, 16-1 to 16-8
LINK menu, 16-2 to 16-8
LinReg, 12-13, 12-15, 12-16,
LIST MATH menu, 11-9, 11-1
LIST OPS menu, 11-6 to 11-8
Lists, x, 11-1 to 11-10
  arguments, 2-3, 11-5
  dimension, 11-6, 11-7, A
  elements, 12-10 to 12-12
  entering, 11-2 to 11-5, 12-12
  graphing, 3-12, 11-5, 13-
  variables, 11-2 to 11-5,
  viewing, 12-10
ln, 2-4, A-10, B-5
LnReg, 12-13, 12-16, A-10, A
log, 2-4, A-11, B-5
Logic operations, 2-16
Logarithm, 2-4
Logarithmic regression, 12-
LOGIC menu, 2-16
Lower bound, 2-8, 3-23, B-6

- G (Cont.) -

raph (continued)
polar, 5-1 to 5-6
sequence, 6-1 to 6-6
reater than: >, 2-15, A-8
reater than or equal: ≥, 2-15, A-8
reatest integer, 2-9, 2-10, 10-11
ridOff, **GridOn** FORMAT, 3-10, A-8
uess, 2-8, 3-22, 3-23, B-6
uidebook, using, viii, ix

- H -

istogram, 12-19 to 12-22, B-9
ome screen, x, 1-4, 9-3
orizontal, 8-3, 8-5, A-8
orizontal line, 8-5
YP (MATH) menu, 2-11
yperbolic functions, 2-11
yperbolic arcsine, arcosine, arctangent. *See* **sinh^{-1}**, **cosh^{-1}**, **tanh^{-1}**

- I -

entity (matrix), 10-12, 10-13, A-8
13-7, 13-8, A-9
LEGAL NEST error, B-7
plied multiplication, 1-21
crement and skip, 13-10
CREMENT error, B-7
dependent variable, 3-5, 7-3, 7-5
dpntAsk, 7-3, 7-5, A-9
dpntAuto, 7-3, 7-5, A-9
put, 13-13, A-9
put to programs, 13-13 to 13-17
PUT/OUTPUT, 13-13 to 13-17
serting, 1-8
structions, x, 1-6, 1-7
, 2-9, 2-10, 10-11, A-9
eger part, 2-9, 2-10, 10-11, A-9
egrals, 2-5, 2-7, 3-21, 3-24, A-7, B-4, B-6
ercepts, 3-21, 3-22, B-4
ersect, 3-21, 3-23, B-4
ersection, 3-21, 3-23, B-4
errupt, 1-7, 13-4
VALID error, B-7
VALID DIM error, B-7

- I (Cont.) -

Inverse: $^{-1}$, 2-3, 10-11, A-9
hyperbolics, 2-11
functions, 8-3, A-5, B-8
logs, 2-4
matrices, 10-11
trigs, 2-3
iPart, 2-9, 2-10, 10-11, A-9
IS>(, 13-7, 13-10, A-9
ITERATIONS error, B-8

- L -

L*n* (lists), 11-2 to 11-5, A-28
LABEL error, B-8
LabelOff, **LabelOn**, 3-10, A-10
Labels (graph), 3-10, A-10
Labels (program), 13-10
Last Answer, 1-16, 13-4
Last Entry, 1-14, 1-15, 13-4
Lbl, 13-7, 13-10, A-10, B-8
Less than: <, 2-15, A-10
Less than or equal: ≤, 2-15, A-10
Line(, 8-3, 8-4, A-10
Line (stat), 12-18, 12-20 to 12-22
Linear regression, 12-15, 12-16
LINK, 16-1 to 16-8
LINK menu, 16-2 to 16-8
LinReg, 12-13, 12-15, 12-16, A-10
LIST MATH menu, 11-9, 11-10
LIST OPS menu, 11-6 to 11-8
Lists, x, 11-1 to 11-10
arguments, 2-3, 11-5
dimension, 11-6, 11-7, A-4
elements, 12-10 to 12-12
entering, 11-2 to 11-5, 12-10 to 12-12
graphing, 3-12, 11-5, 13-2, 13-3
variables, 11-2 to 11-5, A-28
viewing, 12-10
ln, 2-4, A-10, B-5
LnReg, 12-13, 12-16, A-10, A-11
log, 2-4, A-11, B-5
Logic operations, 2-16
Logarithm, 2-4
Logarithmic regression, 12-16
LOGIC menu, 2-16
Lower bound, 2-8, 3-23, B-6

- M -

Mark (STAT), 12-20 12-22
MATH menu, 2-2 to 2-12
Matrices, x, 9-3, 10-1 to 10-14
determinant, 10-12
dimensions, 10-4, 10-12, 10-13
elements, 10-4 to 10-9
entering, 10-4 to 10-9
inverse, 10-11
math, 10-10 to 10-14
row operations, 10-14
transpose, 10-12
variables, 10-4, 10-8, 10-9, A-28
viewing, 10-5
MATRIX EDIT menu, 10-4
MATRX MATH menu, 10-12 to 10-14
MATRX NAMES menu, 10-8, 10-9
max(, 2-9, 2-10, 11-9, A-11
maximum (CALC), 3-21, 3-23, B-4
Maximum, 2-9, 2-10, 3-21, 3-23, 11-9, 12-14, 12-19, 12-21
maxX, **maxY**, 12-14, 12-19, 12-21, A-28
mean(, 11-9, A-11
Med, 12-14, 12-19, 12-21, A-28
Med-Med, 12-13, 12-15, A-11
median(, 11-9, A-11
Median point, 12-19
Median-median line, 12-15
MEM menu, 15-2 to 15-4
MEM screens, 15-2, 15-3
MEMORY error, B-8
Memory backup, 16-8
Memory full message, 16-7, B-3, B-8
Memory management, 15-1 to 15-4
Menu(, 13-7, 13-11, A-11
Menu map, A-22 to A-27
Menus, x, GS-2, 1-17 to 1-19, 9-3
ANGLE, 2-13, 2-14
BOX (VARS), 1-19, 12-14
CALC, 3-21 to 3-24
CTL (PRGM), 13-7 to 13-12
DRAW, 8-3 to 8-11
EQ (VARS), 1-19, 12-14
HYP (MATH), 2-11
I/O (PRGM), 13-13 to 13-17
LINK, 16-2 to 16-8

- M (Cont.) -

Menus (Cont.)
LIST MATH, 11-9, 11-10
LIST OPS, 11-6 to 11-8
MATH, 2-2 to 2-12
MATRX EDIT, 10-4
MATRX MATH, 10-12 to 10-14
MATRIX NAMES, 10-8, 10-9
MEM, 15-2 to 15-4
NUM (MATH), 2-9, 2-10
POINTS (DRAW), 8-12, 8-13
PRB (MATH), 2-12
PRGM EXEC, 13-5, 13-6
PRGM EDIT, 13-5
PRGM NEW, 13-5
PTS (VARS), 1-19, 12-14
Σ (VARS), 1-19, 12-14
STAT CALC, 12-13 to 12-17
STAT EDIT, 12-12
STAT MARK, 12-22
STAT PLOTS, 12-22
STAT TYPE, 12-22
STO (DRAW), 8-14, 8-15
TEST, 2-15
TEST LOGIC, 2-16
VARS, 1-19, 3-8
WINDOW FORMAT, 3-10
X/Y (VARS), 1-19, 12-14
Y-VARS, 1-19
ZOOM, 3-16 to 3-18
ZOOM MEMORY, 3-19 to 3-20, 4-6
min(, 2-9, 2-10, 11-9, A-11
minimum (CALC), 3-21, 3-23, B-4
Minimum, 2-9, 2-10, 3-21, 3-23, 11-9, 12-14, 12-19, 12-21
Minute notation: ', 2-13, A-12
minX, **minY**, 12-14, 12-19, 12-21
MODE, 1-9 to 1-11, 3-4, 4-3, 5-3, 9-3
MODE error, B-8
Modeling, 12-4 to 12-8
Multiargument functions, 1-20
Multiple entries, 1-6, 1-14
Multiplication: *, 2-3, 10-10, A-12

- N -

n (statistics), 12-14, A-28
n (Seq), 6-5, 6-6, 7-3, A-28
Natural log, 2-4
nCr, 2-12, A-12
nDeriv(, 2-5, 2-7, A-12
Negation: **-**, 1-21, 2-4, 10-10, A-12
***n*Max**, ***n*Min**, 6-5, 6-6
Normal MODE, 1-9, 1-10, A-13
NO SIGN CHNG error, B-8
not, 2-16, A-13
Not equal: ≠, 2-15, 10-11, A-13
nPr, 2-12, A-13
***n*Start**, 6-6
NUM (MATH) menu, 2-9, 2-10
Numerical derivative, 2-5, 2-6, 3-21, 3-24, 4-6, 5-6, A-12
Numerical integral, 2-5, 2-7, 3-21, 3-24, A-7, B-4, B-6

- O -

OFF, ON, GS-3, 1-2
1-Var Stats, 12-13, 12-14, A-13, B-9
One-variable statistics, 12-13, 12-14, B-9
or, 2-16, A-13
Output(, 9-4, 13-13, 13-15, A-13
OVERFLOW error, B-8

- P -

Panning, 3-14, 4-6, 5-6, 6-6
Par MODE, 1-9, 1-11, 3-4, 4-3, A-14
Parametrics, 1-19, 4-1 to 4-6
Parentheses, 1-21
Pause, 13-7, 13-10, 13-14, 13-15, 13-17, A-14
Pausing a graph, 3-11
Pausing a program, 13-10
Pen, 8-3, 8-11
Permutations, 2-12
Pi: π, 2-4
Pixel, 3-13, 8-12, 8-13, 9-4, A-15, B-4
Pic*n* (pictures), 1-19, 8-14, A-28
Plot*n***(**, 12-20, 12-22, A-14
PlotsOff, **PlotsOn**, 12-21, A-14
Plotting graphs, 3-11, 3-12
Plotting stat data, 12-6 to 12-8, 12-18 to 12-22

- P (Cont.) -

POINTS (DRAW) menu, 8-12
Pol MODE, 1-9, 1-11, 3-4, 5-
Polar coordinates, 3-10, 4-6, A-14
Polar graphing, 1-19, 5-1 to
PolarGC, 3-10, 4-6, 5-6, 6-5,
Polar to rectangular, 2-13, 2
Polynomial fit/regression, 1
Power of ten: **10^**, 2-4, A-14
Power regression, 12-16
Powers: **^**, 2-3, 10-11, A-14
PRB (MATH) menu, 2-12
prgm, 13-7, 13-11, 13-18, A-
PRGM CTL menu, 13-7 to 1
PRGM EXEC menu, 13-5, 1
PRGM EDIT menu, 13-5
PRGM I/O menu, 13-13 to 1
PRGM NEW menu, 13-5
PrintScreen, 13-13, 13-17,
Probability, 2-2, 2-12
prod, 11-9, 11-10, A-15
Product of a sequence, 11-
PROGRAM editor, 9-3
Programs, 13-1 to 13-18
commands, 13-4
executing programs, 1
names, 13-4
Prompt, 13-13, 13-15, A-15
P▶Rx(, **P▶Ry(**, 2-13, 2-14,
Pt-Change(, 8-12, A-15
Pt-Off(, **Pt-On(**, 8-12, A-15
PTS (VARS) menu, 1-19, 1
PwrReg, 12-13, 12-16, A-1
Pxl-Change(, 8-12, 8-13, 9
Pxl-Off(, **Pxl-On(**, 8-12, 8-1 A-15
pxl-Test(, 8-12, 8-13, 9-4,

- Q -

Q1, **Q3** 12-14, 12-19, 12-21
QuadReg, 12-13, 12-15, A
Quadratic fit/regression, 1
Quartiles, 12-14, 12-19
QuartReg, 12-13, 12-15, A
Quartic fit/regression, 12-
QuickZoom, 3-14, 4-6, 5-6

- N -

n (statistics), 12-14, A-28
n (Seq), 6-5, 6-6, 7-3, A-28
Natural log, 2-4
nCr, 2-12, A-12
nDeriv(, 2-5, 2-7, A-12
Negation: **-**, 1-21, 2-4, 10-10, A-12
***n*Max**, ***n*Min**, 6-5, 6-6
Normal MODE, 1-9, 1-10, A-13
NO SIGN CHNG error, B-8
not, 2-16, A-13
Not equal: ≠, 2-15, 10-11, A-13
nPr, 2-12, A-13
***n*Start**, 6-6
NUM (MATH) menu, 2-9, 2-10
Numerical derivative, 2-5, 2-6, 3-21, 3-24, 4-6, 5-6, A-12
Numerical integral, 2-5, 2-7, 3-21, 3-24, A-7, B-4, B-6

- O -

OFF, ON, GS-3, 1-2
1-Var Stats, 12-13, 12-14, A-13, B-9
One-variable statistics, 12-13, 12-14, B-9
or, 2-16, A-13
Output(, 9-4, 13-13, 13-15, A-13
OVERFLOW error, B-8

- P -

Panning, 3-14, 4-6, 5-6, 6-6
Par MODE, 1-9, 1-11, 3-4, 4-3, A-14
Parametrics, 1-19, 4-1 to 4-6
Parentheses, 1-21
Pause, 13-7, 13-10, 13-14, 13-15, 13-17, A-14
Pausing a graph, 3-11
Pausing a program, 13-10
Pen, 8-3, 8-11
Permutations, 2-12
Pi: π, 2-4
Pixel, 3-13, 8-12, 8-13, 9-4, A-15, B-4
Pic*n* (pictures), 1-19, 8-14, A-28
Plot*n*(, 12-20, 12-22, A-14
PlotsOff, **PlotsOn**, 12-21, A-14
Plotting graphs, 3-11, 3-12
Plotting stat data, 12-6 to 12-8, 12-18 to 12-22

- P (Cont.) -

POINTS (DRAW) menu, 8-12, 8-13
Pol MODE, 1-9, 1-11, 3-4, 5-3, A-14
Polar coordinates, 3-10, 4-6, 5-6, 6-5, A-14
Polar graphing, 1-19, 5-1 to 5-6
PolarGC, 3-10, 4-6, 5-6, 6-5, A-14
Polar to rectangular, 2-13, 2-14, A-15
Polynomial fit/regression, 12-15
Power of ten: **10^**, 2-4, A-14, B-5
Power regression, 12-16
Powers: **^**, 2-3, 10-11, A-14
PRB (MATH) menu, 2-12
prgm, 13-7, 13-11, 13-18, A-14
PRGM CTL menu, 13-7 to 13-12
PRGM EXEC menu, 13-5, 13-6
PRGM EDIT menu, 13-5
PRGM I/O menu, 13-13 to 13-17
PRGM NEW menu, 13-5
PrintScreen, 13-13, 13-17, A-14
Probability, 2-2, 2-12
prod, 11-9, 11-10, A-15
Product of a sequence, 11-10
PROGRAM editor, 9-3
Programs, 13-1 to 13-18
  commands, 13-4
  executing programs, 13-5
  names, 13-4
Prompt, 13-13, 13-15, A-15
P▶Rx(, **P▶Ry(**, 2-13, 2-14, A-15
Pt-Change(, 8-12, A-15
Pt-Off(, **Pt-On(**, 8-12, A-15
PTS (VARS) menu, 1-19, 12-14
PwrReg, 12-13, 12-16, A-15
Pxl-Change(, 8-12, 8-13, 9-4, A-15
Pxl-Off(, **Pxl-On(**, 8-12, 8-13, 9-4, A-15
pxl-Test(, 8-12, 8-13, 9-4, A-15

- Q -

Q1, **Q3** 12-14, 12-19, 12-21, A-28
QuadReg, 12-13, 12-15, A-15
Quadratic fit/regression, 12-15
Quartiles, 12-14, 12-19
QuartReg, 12-13, 12-15, A-16
Quartic fit/regression, 12-15
QuickZoom, 3-14, 4-6, 5-6, 6-6

- R -

r (radian notation), 2-13, A-16
r (statistics), 12-14, 12-15, A-28
R variable, 4-6, 5-6, 5-6, A-28
r*n* functions, 1-19, 5-3, A-28
Radian, 1-9, 1-11, 2-13, 3-4, A-16
rand, 2-12, A-16
randM(, 10-12, 10-13, 16-2, A-16
Random numbers, 2-12, 10-12, 10-13, 16-2, A-16
RANGE. *See* WINDOW
RCL, 1-13, 13-6
RclWindow, 16-4, 16-5
RecallGDB, 8-15, A-16
Recalling, 1-13, 8-14, 8-15, 13-6
RecallPic, 8-14, A-16
Rectangular coodinates, 3-10, 4-6, 5-6, 6-5, A-16
Rectangular to polar, 2-13, 2-14, A-17
RectGC, 3-10, 4-6, 5-6, 6-5, A-16
RegEQ (regression equation), 12-4 to 12-8, 12-14, A-28, B-4
Regressions, 12-4 to 12-8
Relational operators, 2-15, 10-11
Repeat, 13-7, 13-9, A-16
RESERVED error, B-8
Reserved variables, A-28, B-8
Resetting, GS-3, 15-4
Residuals, 12-2 to 12-8
Return, 13-7, 13-12, A-16
root $\sqrt[x]{}$, 2-5, 2-6, A-16
root, 3-21, 3-22, B-4
Root of a function, 3-21, 3-22, B-4
round(, 2-9, 10-11, A-16, A-17
Row operations (matrices), 10-2, 10-3, 10-12, 10-14
rowSwap(, 10-12, 10-14, A-17
row+(, ***row(**, ***row+(**, 10-2, 10-3, 10-12, 10-14, A-17
Running programs, 13-5
R▶Pr(, **R▶Pθ(**, 2-13, 2-14, A-17

- S -

Scatter plot, 12-18, 12-20 to 12-22
Sci MODE, 1-7, 1-9, 1-10, A-17
Scientific notation, 1-7, 1-9, 1-10, A-17
2nd, 1-8
SELECT (LINK) screen, 16-5
SelectAll+, **SelectAll-**, 16-5
SelectCurrent, 16-5
Selecting from a menu, GS-2, 1-17
Selecting functions, 1-19
Send(, 13-13, 13-17, A-17
Sending, 16-1 to 16-8
Seq, 1-9, 1-11, 3-4, 6-3, 7-3, A-17
seq(, 6-5, 11-2, 11-6, 11-8, 11-10, A-17, B-7
Sequence
  generating, 6-5, 11-2, 11-6, 11-8, 11-10, A-17
  graphing, 1-19, 6-1 to 6-6
  product, 11-10
  sum, 11-10
Sequential, 1-9, 1-11, 3-4, A-17
Series, 6-5, 11-10
Service information, B-10, B-11
SET UP CALCS, 9-3, 12-13, 12-17
Shade(, 8-2, 8-3, 8-8, A-18
σx, **σy**, 12-14, A-28
Σ (VARS) menu, 1-19, 12-14
Σx, **Σy**, **Σx²**, **Σy²**, **Σxy**, 12-14, A-28
Simul, 1-9, 1-11, 3-4, 3-12, A-18
sin, **sin⁻¹**, 2-3, A-18, B-5
Sine, 2-3, A-18, B-5
SINGULAR MAT error, B-8
SINGULARITY error, B-9
sinh, **sinh⁻¹**, 2-11, A-18, B-5
Smart Graph, 3-11, 3-24, 4-5, 5-5, 6-5
solve(, 2-5, 2-8, 3-22, A-18, A-19, B-4, B-6, B-8, B-9
Solving equations, 2-5, 2-8, 3-22, A-18, A-19, B-4, B-6, B-8, B-9
SortA(, 11-6, 12-12, 12-18, A-19
SortD(, 11-6, 12-12, 12-18, A-19
Sorting lists, 11-6, 12-3, 12-12

- S (Cont.) -

Split, 1-9, 1-11, 9-4, A-19
Split screen, 9-1 to 9-4, 8-10, 8-13, 13-15
Square: **²**, 2-3, 10-11, A-19
Square root: √, 2-3, A-19, B-5
Standard deviation, 12-14
Square WINDOW, 3-2, 3-16, 3-18, A-21
Standard WINDOW, 3-8, 3-16, 3-18, 4-6, 5-6, A-21
STAT error, B-9
STAT CALC menu, 12-13 to 12-17
STAT EDIT menu, 12-12
STAT list editor, 9-3, 12-9 to 12-12
STAT MARK menu, 12-22
STAT PLOT error, B-9
STAT PLOTS, 9-3, 12-20, 12-22
STAT TYPE menu, 12-22
Statistics, 1-19, 12-1 to 12-22
  analysis, 12-2 to 12-9, 12-13 to 12-22
  calculations, 12-2 to 12-9, 12-13 to 12-17
  data, 12-9 to 12-11
  plotting, 12-6 to 12-8, 12-18 to 12-22
  results, 1-19, 12-4, 12-5
  variables, 1-19, 12-4, 12-5
STO (DRAW) menu, 8-14, 8-15
Stop, 13-7, 13-12, A-19
Stopping, 1-7, 3-11, 13-4, 13-12
Store: **→**, 1-13, 11-3, A-19
StoreGDB, 8-15, A-19
StorePic, 8-14, A-19
Storing, 1-13, 8-14, 8-15
Subroutines, 13-10, 13-18
Subtraction: **−**, 2-3, 10-10, A-19, A-20
sum, 11-9, 11-10, A-20
Sum of a sequence, 11-10
Summation, 11-10
Sx, **Sy**, 12-14, A-28
SYNTAX error, B-9
System variables, A-28

- T -

T (transpose), 10-12, A-20
T variable, 4-5, 4-6, 7-3, A-
Tables, GS-7 to GS-9, 7-1
TABLE SETUP screen, 7-2
Table variables, 1-19
tan, **tan⁻¹**, 2-3, A-20, B-5
Tangent(, 8-3, 8-6, A-20
Tangent line, 8-6
tanh, **tanh⁻¹**, 2-11, A-20, B
TblMin, 1-19, 7-2, 7-3, 7-5,
TEST menu, 2-15
TEST LOGIC menu, 2-16
Text(, 8-3, 8-10, 9-4, A-20
Then, 13-7, 13-8, A-20
θ variable, 4-6, 5-5, 5-6, 7-
θmax, **θmin**, 5-4, 5-5, 5-6,
θstep, 5-4, 5-5, 5-6, B-4, B
Time FORMAT, 6-4 to 6-6,
Tmax, **Tmin**, 4-4, 4-5, B-4,
TOL NOT MET error, B-9
Tolerance, 2-6, 2-7, 3-23,
Trace, 3-15, A-20
TRACE, GS-11, 3-14, 3-15, 6-5, 9-3, 12-21
Transmitting, 16-1 to 16-8
Transpose: **T**, 10-12, A-20
Trig functions, 2-3
Tstep, 4-4, 4-5, B-4, B-9
Turning functions on and
Turning the TI-82 on and
2-Var Stats, 12-13, 12-14,
Two-variable statistics, 12

- U -

U*n*, **U*n-1***, 1-19, 6-2 to 6-6,
UNDEFINED error, B-9
U*n*Start, 6-4, 6-6, A-28
Upper bound, 2-8, 3-23, B

- S (Cont.) -

Split, 1-9, 1-11, 9-4, A-19
Split screen, 9-1 to 9-4, 8-10, 8-13, 13-15
Square: ^{2}, 2-3, 10-11, A-19
Square root: √, 2-3, A-19, B-5
Standard deviation, 12-14
Square WINDOW, 3-2, 3-16, 3-18, A-21
Standard WINDOW, 3-8, 3-16, 3-18, 4-6, 5-6, A-21
STAT error, B-9
STAT CALC menu, 12-13 to 12-17
STAT EDIT menu, 12-12
STAT list editor, 9-3, 12-9 to 12-12
STAT MARK menu, 12-22
STAT PLOT error, B-9
STAT PLOTS, 9-3, 12-20, 12-22
STAT TYPE menu, 12-22
Statistics, 1-19, 12-1 to 12-22
  analysis, 12-2 to 12-9, 12-13 to 12-22
  calculations, 12-2 to 12-9, 12-13 to 12-17
  data, 12-9 to 12-11
  plotting, 12-6 to 12-8, 12-18 to 12-22
  results, 1-19, 12-4, 12-5
  variables, 1-19, 12-4, 12-5
STO (DRAW) menu, 8-14, 8-15
Stop, 13-7, 13-12, A-19
Stopping, 1-7, 3-11, 13-4, 13-12
Store: →, 1-13, 11-3, A-19
StoreGDB, 8-15, A-19
StorePic, 8-14, A-19
Storing, 1-13, 8-14, 8-15
Subroutines, 13-10, 13-18
Subtraction: –, 2-3, 10-10, A-19, A-20
sum, 11-9, 11-10, A-20
Sum of a sequence, 11-10
Summation, 11-10
Sx, **Sy**, 12-14, A-28
SYNTAX error, B-9
System variables, A-28

- T -

^{T} (transpose), 10-12, A-20
T variable, 4-5, 4-6, 7-3, A-28
Tables, GS-7 to GS-9, 7-1 to 7-6
TABLE SETUP screen, 7-2, 7-3, 9-3
Table variables, 1-19
tan, **tan^{-1}**, 2-3, A-20, B-5
Tangent(, 8-3, 8-6, A-20
Tangent line, 8-6
tanh, **tanh^{-1}**, 2-11, A-20, B-5
TblMin, 1-19, 7-2, 7-3, 7-5, 12-4, 12-5
TEST menu, 2-15
TEST LOGIC menu, 2-16
Text(, 8-3, 8-10, 9-4, A-20
Then, 13-7, 13-8, A-20
θ variable, 4-6, 5-5, 5-6, 7-3, A-28
θmax, **θmin**, 5-4, 5-5, 5-6, B-4, B-9
θstep, 5-4, 5-5, 5-6, B-4, B-9
Time FORMAT, 6-4 to 6-6, A-20
Tmax, **Tmin**, 4-4, 4-5, B-4, B-9
TOL NOT MET error, B-9
Tolerance, 2-6, 2-7, 3-23, 3-24
Trace, 3-15, A-20
TRACE, GS-11, 3-14, 3-15, 4-6, 5-6, 6-5, 9-3, 12-21
Transmitting, 16-1 to 16-8
Transpose: ^{T}, 10-12, A-20
Trig functions, 2-3
Tstep, 4-4, 4-5, B-4, B-9
Turning functions on and off, 1-19
Turning the TI-82 on and off, 1-2
2-Var Stats, 12-13, 12-14, A-21
Two-variable statistics, 12-13, 12-14

- U -

U*n*, **U*n-1***, 1-19, 6-2 to 6-6, 11-8, A-28
UNDEFINED error, B-9
U*n*Start, 6-4, 6-6, A-28
Upper bound, 2-8, 3-23, B-6

- V -

value, 3-21, 4-6, 5-6
Variables, x, 1-22, 1-23, A-28
VARS menu, 1-19, 3-9
Vertical, 8-3, 8-5, A-21
Vertical line, 8-5
Viewing rectangle, viewing window. *See* WINDOW
V*n*, **V*n-1***, 1-19, 6-2 to 6-6, 11-8, A-28
V*n*Start, 6-6, A-28

- W -

WARNING Memory Backup message, 16-8
Warranty information, B-12
Web FORMAT, 6-5, 6-6, A-21
While, 13-7, 13-9, A-21
WINDOW, GS-10, 1-19, 3-8 to 3-9, 3-16 to 3-20, 4-3 to 4-6, 5-4 to 5-6, 6-4 to 6-6, 12-21, 13-15, A-28, B-8
WINDOW FORMAT, 3-10, 9-3
WINDOW RANGE error, B-9

- X -

X,T,θ key, 3-5, 4-3, 5-3
X, 3-5, 4-5, 4-6, 5-5, 5-6, 6-5, 6-6, 7-3, A-28, B-4
$\bar{x}$, 12-14, A-28
x1, **x2**, **x3**, 12-14, 12-15, A-28
XT*n* functions, 1-19, 4-3, A-28
XFact variable, 3-17, 3-19, 3-20
Xlist, 12-20
Xmax, **Xmin**, **Xscl**, 3-8, 3-13, 3-18, 4-4, 4-6, 5-4, 5-6, 6-4, 6-6, 12-19, 13-15, A-28, B-4, B-9
xor, 2-16, A-21
X/Y (VARS) menu, 1-19, 12-14
xyLine, 12-18, 12-20 to 12-22

- Y -

$\bar{y}$, 12-14, A-28
Y, 3-8, 4-5, 4-6, 5-5, 5-6, 6-5, 6-6, A-28, B-4
Y-VARS menu, 1-19
Y*n*, 1-19, 3-5 to 3-7, 13-15, A-28
y1, **y2**, **y3**, 12-14, 12-15, A-28
YT*n* functions, 1-19, A-28
Y= editor, 1-19, 3-5 to 3-7, 4-3, 5-3, 6-3, 7-4, A-28
Y= functions. *See* **Y***n*, **r***n* **X**T*n*, **U***n* functions
YFact variable, 3-17, 3-19, 3-20
Ylist, 12-20
Ymax, **Ymin**, **Yscl**, 3-8, 3-13, 3-18, 4-4, 4-6, 5-4, 5-6, 6-4, 6-6, 12-19, 13-15, A-28, B-4, B-9

- Z -

ZBox, 3-16, A-21
ZDecimal, 3-16, 3-18, A-21
Zero of a function, 3-21, 3-22, B-4
ZInteger, 3-16, 3-18, A-21
ZOOM, GS-12, 1-19, 3-16 to 3-20, 4-6, 9-3
ZOOM error, B-9
ZOOM FACTORS, 3-17, 3-19, 3-20
ZOOM MEMORY, 3-19 to 3-20, 4-6
ZOOM menu, 3-16 to 3-18
Zoom In, 3-16, 3-17, 3-20, A-21
Zoom Out, 3-16, 3-17, 3-20, A-21
ZoomRcl, 3-19, 4-6, 5-6, A-21
ZoomSto, 3-19, 4-6, 5-6, A-21
ZoomStat, 3-16, 3-18, 12-19, 12-21, A-21
ZPrevious, 3-19, A-21
ZSquare, 3-2, 3-16, 3-18, 5-2, A-21
ZStandard, 3-16, 3-18, 4-6, 5-6, A-21
ZTrig, 3-16, 3-18, A-21
Zθ**max**, **Z**θ**min**, **Z**θ**step**, 5-6, A-28
ZTmax, **ZTmin**, **ZTstep**, 4-6, A-28
Z*n***Max**, **Z***n***Min**, **Z***n***Start**, 6-6, A-28
ZU*n***Start**, **ZV***n***Start**, 6-6, A-28
ZXmax, **ZXmin**, **ZXscl**, 3-19, A-28
ZYmax, **ZYmin**, **ZYscl**, 3-19, A-28

ΔTbl, 7-2, 7-3, 7-6
ΔX, **ΔY**, 3-9, 3-18, A-28, B-4
ε, 2-7, 3-24
σx, **σy**, 12-14, A-28
Σ (VARS) menu, 1-19, 12-14
Σx, **Σy**, **Σx²**, **Σy²**, **Σxy**, 12-14, A-28
θ, 4-6, 5-5, 5-6, 7-3, A-28
θmax, **θmin**, 5-4, 5-5, 5-6, B-4, B-9
θstep, 5-4, 5-5, 5-6, B-4, B-9

ΔTbl, 7-2, 7-3, 7-6
ΔX, **ΔY**, 3-9, 3-18, A-28, B-4
ε, 2-7, 3-24
σx, **σy**, 12-14, A-28
Σ (VARS) menu, 1-19, 12-14
Σx, **Σy**, **Σx²**, **Σy²**, **Σxy**, 12-14, A-28
θ, 4-6, 5-5, 5-6, 7-3, A-28
θmax, **θmin**, 5-4, 5-5, 5-6, B-4, B-9
θstep, 5-4, 5-5, 5-6, B-4, B-9

TI-82 Chapter Contents

Introduction	Table of Contents and Glossary
Getting Started	Do This First!
Chapter 1	Operating the TI-82
Chapter 2	Math, Angle, and Test Operations
Chapter 3	Function Graphing
Chapter 4	Parametric Graphing
Chapter 5	Polar Graphing
Chapter 6	Sequence Graphing
Chapter 7	Tables
Chapter 8	DRAW Operations
Chapter 9	Split Screen
Chapter 10	Matrices
Chapter 11	Lists
Chapter 12	Statistics
Chapter 13	Programming
Chapter 14	Applications
Chapter 15	Memory Management
Chapter 16	Communication Link
Appendix A	Tables
Appendix B	Reference Information
Index	

Printed in U.S.A.

G.B.Co.
1038700-0101